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FORMERLY GENERAL SCIENCE QUARTERLY

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Science Education

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» » Contents « «

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Science Education

Volume 16 APRIL, 1932 Number 4

Editorial Notes and Comments

Science Education Adopted as the Official Organ of The National Council of Supervisors of Elementary Science

At the meeting of the National Council of Supervisors of Elementary Science, held at Washington, D.C., on February 20, it was voted that SCIENCE EDUCATION be requested to become the official organ of the National Council. It was further decided to select one of the members of the National Council to act as representative on the Editorial Board of the journal, should the request be granted.

It is a pleasure to announce to the readers of the journal and especially to those who are interested in science at the elementary-school level that Dr. Lois Meier Shoemaker of the New Jersey State Teachers College at Trenton will be the representative of the National Council on the Editorial Board of the journal. The Editorial Board welcomes Dr. Shoemaker as a new member of the group. Dr. Shoemaker's interest in the field of elementary science and her extensive studies of practices in this field, both in this country and in foreign countries, admirably qualifies her to act in this capacity. Members of the National Council should send articles, news and announcements, and any other materials for publication in the journal to Dr. Shoemaker.

Progress in the Teaching of Science

As our sphere of knowledge in any field increases in size the number of points of contact with the sphere, that is, the number of unsolved problems,

grows larger. Each idea suggests new ideas; activity leads to activity. To the extent that the new idea, or the composite sphere of new ideas, is brought to the consideration of many minds—to that extent it is likely to be tested, confirmed, modified, or rejected. It is the spirit of science to set up hypotheses and to subject these to the test of reflective thinking and scientific experimentation. And it is one aspect of scientific attitude to hold that man's conception of truth changes to the degree that ideas are subjected to criticism and weighed in the balance of truth by scientific procedures.

In this issue of the journal there appears a Symposium on the recently published *Thirty-First Yearbook,* Part I, of the National Society for the Study of Education, entitled "A Program for Teaching Science." The Yearbook represents the present ideas of a group of men interested in promoting the better teaching of science in our public schools. In the opinion of the writer, the composite of the ideas expressed in the Yearbook has been published as a hypothesis—as a tentative conclusion concerning the practice of the teaching of science. This hypothesis may be correct; it will likely be modified in the future; it may be rejected. At all events it should be subjected to the scrutiny of scientific thinking. It is representative of the views of a certain group of individuals. The Symposium on the other hand represents a series of comments on the hypothesis set forth by those who prepared the Yearbook. These comments are based upon the experiences of the writers. As each individual reads the Yearbook and the Symposium, he, if open minded, is likely to emerge from the experience with a conclusion concerning the teaching of science, which is in some ways in agreement with and in other respects at variance with the points of view expressed by the authors. This type of emergence is a promising and mentally healthful symptom of the future progress in the teaching of science.

Science Education finds its proper place as an educational periodical to the degree that it can include in its pages a variety of tested points of view on matters relating to science teaching and to the extent to which the expressed points of view are representative of the entire group for which the journal was established. It is with the latter point in mind that the editor wishes to urge every reader to avail himself of the right to be represented in the field of science education by publishing his thought in the pages of Science Education.

We plan to publish a second symposium if the readers of the journal will contribute an expression of their views whether they are in accord or at variance with the views contained in the Yearbook and in the present Symposium.

—C.J.P.

Leaders in Education

Bibliographies and directories appear to be growing in popularity. They represent one means of keeping us in touch with men and deeds in this age of ever-increasing activity, and to this end are valuable. A recent volume, entitled *Biographical Directory of Leaders in Education* and edited by J. McKeen Cattell, is described in the quotations below which are taken from a press notice sent by the editor.

> The *Biographical Directory of Leaders in Education* will take a place among the most important works of reference. Material for the book has been in course of collection for a number of years along the lines of the *Biographical Directory of American Men of Science,* which in successive editions has been a standard work for twenty-five years. The two directories are under the same editorship, as are also *Science* and *School and Society,* weekly journals, the former of which since 1895, the latter since 1915, have maintained the highest position in the fields of science and of education.
>
> The *Biographical Directory of Leaders in Education* will contain biographies of about 11,000 of those in America who have done the most to advance education, whether by teaching, writing, research or administration, a careful selection from the million educational workers of the United States and Canada. They are those to whom daily reference is made in the press, from whom all positions of importance are filled. It will be a work essential to all who have relations with those engaged in educational work, necessary to every reference library.
>
> *Leaders in Education,* like *School and Society,* aims to bring unity and common interest into educational work, covering the field from the nursery school and before to the university and after, including libraries, museums and social agencies as important factors in education. Like *American Men of Science* it is more than a compilation; it is a contribution to the advancement of education.
>
> Not only on the editorial side but also in mechanical production, the book will maintain the standards of *American Men of Science,* being well printed and well bound, a book satisfactory for any student or any library to own, to show, and to use.

This volume is published by *The Science Press,* Grand Central Terminal, New York City, and Lancaster, Pennsylvania.

Some Contributions of Research to Practices in Science Teaching*

Francis D. Curtis
University of Michigan

Science teaching, like the scientific method, may be said to be as old as man is old. The success of primitive man as a competing organism depended upon his ability not only to apply to the interpretation of his environment a rudimentary sort of scientific method, but also to impart to others of his horde some of the wood-craft and animal lore which he had learned through the trial and error process of his own living, through imitation of others, or through such direct instruction as he may have received. His success in acquiring some degree of expertness in interpreting phenomena and in reasoning from effect to cause, and later from cause to effect, enabled primitive man to survive as an individual; his success in imparting the slowly accumulating increments of this knowledge enabled him to survive as a social being.

Thus it may be said that in the earlier stages of the race all education was science education. As man slowly evolved into and through savagery, through barbarism into a state of civilization, the imperative necessity for teaching to every individual some facts and elementary principles of science as equipment essential to his survival gradually diminished and eventually disappeared except on the frontiers. Education broadened in its scope and purpose; the teaching of science became only one of many phases or divisions of education. The progress toward and into civilization brought in time the invention of methods and devices of teaching the various developing branches of learning. Of these methods and devices from other fields, the ones which gave promise of being of more or less general application were given a trial wherever they promised to prove effective in the teaching of science. At the same time there was also a substantial contribution to the art and science of teaching through a progressive refinement of the methods of the scientist. Thus throughout the centuries the teaching of science has been both a product of the development of human culture and a factor contributing to this culture.

From its earliest beginnings almost to the present, however, modifica-

* Delivered before the National Society for the Study of Education at the meeting for the presentation and discussion of their *Thirty-first Yearbook, Part I, A Program for Teaching Science*, Saturday evening, February 20, 1932, at Washington, D.C.

tions in methods and devices, and changes in materials and practices of science teaching have been effected solely on the basis of speculation and opinion based upon the apparent success or failure through trial of the method or material in question. The dawn of a new era in the teaching of science came during the first decade of the present century with the first published reports of pioneer research investigations in this field.

In summary, then, a very brief scrutiny of the history of the teaching of science indicates three more or less definite but overlapping stages: a rudimentary science instruction, primitive but pragmatic, which has existed probably through several millennia; a more or less formalized and elaborate teaching of science which has been in use for many centuries; and a progressive refinement in methods, devices, materials, and practices in the light of research which has been known for only about a quarter century. What changes could have been effected by an instrument still in its formative stages during so short a space of time as a quarter century, in methods and practices so firmly set by the forces of educational conservatism and inertia?

First let us consider how extensive this newly instituted research movement in so restricted a field as the teaching of science has been. Since the reports of the first investigations in the teaching of science began to appear, several hundred studies have been published and this number has been increasing in a geometric ratio. These, moreover, represent only a relatively small fraction of the investigations completed in this field because for a number of reasons most of the studies have remained unpublished. The published reports of investigation cover a wide range of problems and vary in length from a paragraph or so to book-length monographs. One recent collection of digests of research investigations in this field includes summaries of twenty-two Doctors' dissertations and of several other studies equivalent in extent and dignity to a Doctor's dissertation. Some of these investigations, especially the earlier ones, were necessarily very crude and can now be considered of little practical value; but it must be remembered that these were pioneer efforts and that many of the techniques and measuring instruments employed had to be invented by the investigators as the work progressed. On the whole, moreover, the research contributions to the multiple phases of the teaching of science compare favorably with those of any other field of education.

What have been some of the important results of the studies in this field? Among the more important might be listed these:

1. The investigations have contributed to the interest in research as a scientific approach to a solution of teaching problems;

2. They have stimulated a desire for better teaching by promising help in securing more effective teaching;

3. They have encouraged the invention of new methods and of various modifications of older methods;

4. They have directed attention to supplementary and auxiliary teaching devices and materials;

5. They have revealed the possibilities of greater economies in equipping and administering laboratory work;

6. They have made substantial contributions to methods and techniques of research in education;

7. They have rendered more effective the efforts to unite theory with practice.

From these results and from others which might be named it will be seen that the cumulative benefits resulting from research in this field of education have been great with respect not only to the teaching of science but also to teaching in general. A fair presentation of this subject, however, demands that attention be called, also, to the debit side of the ledger. In a movement so new and so enthusiastically promoted, it has been inevitable that there should be some harmful outcomes. As compared with the positive benefits these have been few; nevertheless their detrimental effects upon the progressive improvement of science teaching cannot be ignored. Among these injurious results of the research movement in the teaching of science might be listed these:

1. Many classroom teachers have engaged in research without either possessing the necessary training or securing expert guidance. The findings which they have thus obtained are practically or wholly without value, yet in many cases these conclusions have been made the bases of more or less sweeping changes not only in the classes of these teacher-investigators but also in those of other teachers of science in their schools and in a few instances even in entire school systems.

2. In some quarters the results of research, especially of the extensive investigations of the more complex problems, or of those studies made by leading investigators in the field, have been accepted as facts when they were at best fragmentary or were open to more or less serious criticism on technical or statistical grounds.

3. Several investigators have used the conclusions which they drew from their research as the means of putting the stamp of authority upon their personal biases, prejudices, and opinions. Among the most flagrant offenders on this count were a few university teachers of pure science, who possessing positive ideas with regard to certain phases of science teaching at the high-

school level, but having no knowledge whatever of methods of educational research, used the results of their crude and amateurish investigations to lend force and authority to their thinly veiled propaganda.

4. Many administrators and supervisors have accepted research findings which seemed to favor a policy which the pressing necessities of economical administration have influenced them to adopt, and accordingly have instituted drastic changes which the experimental results, even to the extent to which they could be accepted as valid, have failed wholly to justify. A conspicuous example of this practice is furnished by the controversy over the relative merits of the individual and the demonstration plans of laboratory experimentation. More research studies have been made of this problem than of any other in the field of the teaching of science. The earlier ones of these investigations rendered a real service in presenting a large volume of data which indicated that there were positive values to be derived from the practice of having teachers or pupils demonstrate laboratory exercises before the class. More than this the findings obtained from this cumulative research indicated that for certain types of laboratory exercises, or for the effecting of certain aims, the demonstration method was probably superior to the method of individual pupil experimentation. But none of these investigations presented data which could be accepted as proof that the individual method should be eliminated from the work in science on the grounds that it lacked positive educative values; in fact recent investigation has presented proof which is very convincing, that for the effecting of certain aims and objectives the method of individual pupil experimentation is superior to the method of teacher or pupil demonstration. Yet, influenced more or less strongly, no doubt, by the greater economies possible through the use of the demonstration plan, administrators here and there accepted the results of the earlier investigations of this problem as proof of the superiority of the demonstration plan over the individual plan of laboratory experimentation and proceeded at once to eliminate the latter entirely from their schools. This administrative policy was carried to so ridiculous an extreme that in more than one large city, otherwise modern high school buildings were constructed with no provision whatever for individual pupil experimentation in connection with any of the science courses offered in those schools.

Let us consider now some of the most common types of research investigations in this field. The studies may be catalogued in several ways, but for convenience they may be roughly grouped with not many exceptions as learning studies or as curricular studies. The learning studies are those which present "objective data upon the relative effectiveness of *different*

methods, the determination of the strong and weak points of *particular* methods, and the evaluation of certain teaching devices and practices.[1] The curricular studies include investigations not only of actual subject matter and other materials of instruction, of aims and objectives, and of the trends and other historical aspects of the science curriculum and of science teaching, but also of certain phases of comparative education involving the teaching of science. Thus the learning studies are concerned with statistical evaluations, the methods, devices, and techniques which assist learning, and with the testing and measurement of learning; the curricular studies have to do with the materials used in achieving the objectives of science teaching.

The earliest published learning study in the field of science teaching was an investigation of the relative merits of two methods of teaching high school zoölogy.[2] An overwhelming majority of the learning studies which have followed it have been concerned with learning problems in the field of high school science. Few investigations of outstanding merit have been published on learning problems at the college level until the appearance of the University of Minnesota Series in 1929 and 1930. Published learning studies in the elementary field have been scarcely more numerous than in the college field.

The earliest published curricular study in this field was an investigation by Trafton of the nature interests of children in the upper grades.[3] But with the curricular studies as with the learning studies, most of the research has had to do with problems at the high school level. Practically all the investigations of curricular problems in the teaching of science at the college level have appeared since 1924 while most of the outstanding studies of curricular problems in elementary science have appeared during the past decade.

What are some of the most outstanding investigations of problems in the teaching of science? The task of selecting the *most* important research contributions from the many studies is an impossible one because as yet no technique has been devised for an objective evaluation of this kind.

It is unlikely, moreover, that a marshalling of expert judgment for the purpose of selecting the most significant research contributions in this field would include in a brief list all of the following investigations and only these; nevertheless a recent pooling of such judgment expressed by the members of the National Association for Research in Science Teaching chiefly since 1924[4] indicates that many of the contributions which will now be mentioned are regarded by those most competent to express such a judgment, as of outstanding significance and merit:

1. The accumulation of data bearing upon the merits and values of

general science. During the past ten years a number of investigators have attacked this problem from several angles and with differing degrees of refinement of statistical technique. These investigations have produced data which indicate varying kinds and amounts of values inherent in the general science course, but without exception these values are positive and, taken as a whole would seem to indicate an ample justification for the inclusion of general science in the science curriculum.

2. The studies leading to the emergence of a definite and sequential content of elementary science to replace nature study throughout the grades. It has long been recognized by leaders in the field that much of the earlier work in nature study has merited the criticism that it has been unscientific, incidental, or inconsequential. The extensive and intensive work of Craig and Palmer, independent pioneer investigators into the content and sequence of materials in this field, is especially to be commended.

3. The definition, refinement, and evaluation of various methods and techniques of directed study. The work of Beauchamp[5] on this problem is of paramount importance not only to teachers of science but also to teachers of every other subject at the intermediate and the secondary levels.

4. The determination and evaluation of the principles fundamental to the various branches of science. This monumental contribution is largely the result of pioneer research by Downing and by graduate students under his capable leadership and direction. The importance of this work lies not only in the list of definite principles which are determined and are made available both at the high school and for certain subjects at the college level, but also in its shifting of emphasis from the mere teaching of subject-matter topics to that of building concepts of principles which will function in daily life.

5. Studies leading to the planning of laboratories and equipment. The most extensive and practical of the studies of this group would include that by Jensen and Glenn[6] and similar independent work by Meister, Watkins and Powers.

6. Studies of the nature of the vocabulary appropriate to courses in science and of the appropriateness of the vocabularies found in certain science textbooks from the standpoint of difficulty and familiarity. The most important investigations in this group are two studies by Powers[7] the effect of which upon textbook materials has already been marked and promises to result in a still further strong and salutary influence toward more simplified vocabularies and a smaller vocabulary load in science textbooks of all sorts.

7. The three independent studies by Hurd,[8] Johnson[9] and Noll[10] of problems in the teaching of science at the college level. These studies are of commanding importance not only because of the masterly investigational techniques employed in them but also because they constitute an important step in the movement to place major emphasis upon the effectiveness of instruction in college courses.

8. Contributions to the measurement of various unique outcomes of science teaching. The pioneer research in testing by Caldwell as a part of his investigation of science in the Gary schools remains an outstanding classic; with this should be listed the unique contributions of Webb, of Glenn, of Pieper, and of Downing.

With this very brief list of major contributions of research in the teaching of science let us consider the question of what constitute some important next steps of investigation in this field. The task of selection here is practically as difficult as the previous one of choosing a limited number of most important studies already reported. The following groups of problems, however, may be considered as among those which promise to be especially fruitful:*

1. The determination through various analyses of the desirable and practicable outcomes of classroom and laboratory work, as the logical and practical basis for investigations into the relative merits of a wide variety of teaching methods as means of securing these specific outcomes.

2. Analyses for the purpose of determining a wider variety of profitable classroom, laboratory, and extra-classroom activities, devices, and practices distinct from teaching methods, with objective determinations of the relative values of these.

3. Construction of standardized group tests for measuring a large number of outcomes of instruction other than a knowledge of subject matter.

4. Synthetic curricular researches aiming to combine and utilize in an objective way the findings of miscellaneous related curricular studies.

5. Further analyses of objectives looking toward the determination of the influences which science may exert in molding thought. Especially desirable in this connection are studies for the purpose of further determining and refining the major generalizations of science with their accompanying scientific attitudes and the methods by which these may most effectively and most universally be taught.

In conclusion it is platitudinous to state that no discussion of research

* This list is amended from that prepared by the Committee on Research in High School Science of which the author was chairman, and which was reported in the *Sixth Yearbook* of the Department of Superintendence. Washington, D.C.: The National Education Association, 1928. p. 358.

can be more than a progress report, since no problem has yet been solved; in fact it seems not unlikely that the results of more exhaustive, more highly refined investigation will cause us to modify within the next few years or to discard entirely in favor of others, many of the materials and teaching methods of science instruction concerning the positive values of which we now feel most strongly assured.

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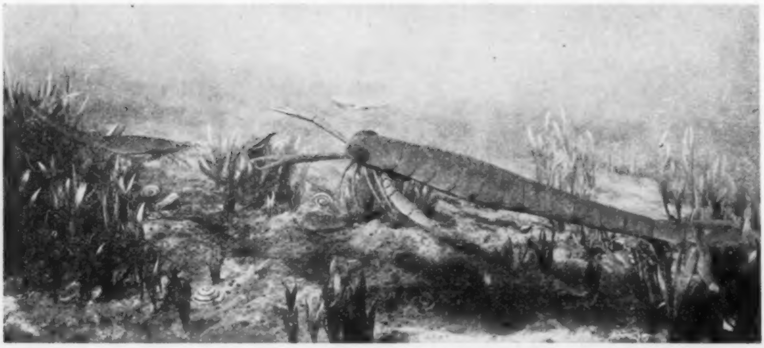
Eurypterid-Hercynella Buffaloensis

Buffalo Museum of Science
Buffalo, New York



There is now exhibited in the Leslie J. Bennett Alcove in the Hall of the Niagara Frontier at the Buffalo Museum of Science the Eurypterid Group, the work of George and Paul Marchand of the Preparation Department of that Museum.

Modelled in wax with the utmost accuracy and finesse, these eurypterids, derived from Greek words meaning broad and wing, represent some of the mighty race of crustaceans, or shellfish, that once ruled the seas where Buffalo now stands.

Buffalo at one time was covered with tropical seas through which swept giant eurypterids, some of them nine feet in length. In their general shape eurypterids look like scorpions, and their closest living relative is the horseshoe crab of the Atlantic coast.

"Are eurypterids alive today?" you ask. Possibly you want to know where you can go and catch a nice, friendly eurypterid. It can't be done, because eurypterids in the flesh, as it were, are not available for family pets nor can you go down to the lake's edge and find one for a playmate.

When eurypterids died, they didn't change into dust, even as you and I will, but they became fossils imbedded in limestone. A fossil, you will remember, is any remains, impression, or trace of an animal or plant of past geological ages preserved in a stratified deposit. And a stratified deposit is one that is laid in layers.

"Then how does one go about getting an eurypterid?" you want to

know. Well, after all, an eurypterid is not an acquisition to any home, as the demand for it on the part of individuals is low, but the eurypterid is certainly a valuable addition to a museum. Therefore, the best way to meet Mr. Eurypterid is to go to the Buffalo Museum of Science which contains what is probably the largest collection of Upper Silurian eurypterids in the world.

The Marchand Eurypterid Group shows many different kinds of eurypterids, some swimming and others crawling over the sea bottom. Probably these sea fellows enjoyed a good meal of worms, although we never really shall know just what food they considered tempting because worms are seldom found as fossils. However, realistic, picturesque, red worms are shown in the group and give a touch of color as well as indicate what was what on the menu 500,000,000 years before the days of vitamins and calories. Along the waving seaweed may be seen the coiled shells of long extinct relatives of our modern squids and pearly nautilus and the almost flat, oval-shaped shell of a simple type of snail. Snails, lowly as they are, can be vastly important. One type of those snails helped to put Buffalo on the map, the scientific map that is. Its name is *Hercynella buffaloensis* and it was so christened because it was first made known to science through its occurrence at Buffalo.

If eurypterids are few and far between, it may be that questions will be asked as to where the Museum's eurypterids came from. They came from the Bennett Quarries in Buffalo when men were digging the foundation of the present Bennett High School in that city. This was rather a strange coincidence because fossil is from a French word meaning dig, and dig the workmen did, and fossils in the form of eurypterids they did find. Foresighted Lewis Bennett instructed them to save all of the eurypterid specimens they found in the process of quarrying the waterlime. This accounts for the extensive collection at the Buffalo Museum of Science. Eurypterids are no longer found in the Bennett Quarries, but Leslie J. Bennett, the son of the donor of the Museum's notable collection, has given a substantial sum to provide for the care and exhibitions of the specimens.

Prominently displayed on the seal of the Buffalo Society of Natural Science is an eurypterid which is also shown on the stationery and publications of the Society. It is there because the eurypterid has played an important part in the Society's history. Both from the popular and from the scientific point of view the eurypterids compose one of the most interesting collections in the Museum. The beautifully preserved specimens lend themselves well to exhibition and reconstruction. Several restorations may

be seen in the Alcove of Local Geology and in the Hall of Geology and Paleontology at that Museum. In the latter hall five exhibit cases are devoted to selected specimens from the eurypterid collection, and a sixth case is given over to the fossils which are associated with them.

A great deal of work must be done before even specimens as good as those from the Bennett Quarries are first-class exhibit material. In the first place the thing that every one wants to know about a specimen is —what is it? This may appear to be a relatively simple question, but it's not always an easy one to answer. The material must be studied in detail and the fossils compared with living organisms before the species can be placed in their proper pigeon-holes in the animal kingdom. Of course after this has once been done for a group of fossils, new specimens can be identified by comparison with those already classified.

In the sea of Upper Silurian age which covered Buffalo and extended westward into Canada and eastward into eastern New York, the eurypterid was probably the monarch of all he surveyed. In this sea some of the eurypterids swam; others crawled about on the bottom and burrowed in the mud, still others did both. Some were able to catch living prey, while others were scavengers and cleaned up the sea bottom.

The eurypterid's kingdom in the sea is no more. His days are done, but his history lives after him in the Buffalo Museum of Science where his importance is probably much greater now than when he was just a creature of the deep.

High School Chemistry Clubs*

Louis A. Astell

Illinois Junior Academy of Science, Sycamore, Illinois

Whether individual hobbies remain merely harmless forms of pastime or rise to the level of serious art or science is not of great importance. It is important only that avenues of wholesome recreation be opened in all directions that lead to playing with stars and ions and the splendid bursts of imagination.

Benjamin C. Gruenberg[1]

The entire subject of chemistry is probably as well organized, supervised, administered, and integrated with advance information as is any other one science at the secondary school level. This statement is reflected somewhat through the kinds of science clubs found at this school level. In a total of 155 high school science clubs, then, it is not surprising to find as many as 79 clubs concerned with the subject of chemistry. No less than 25 of the 79 clubs considered chemistry to the exclusion of all other sciences, in spite of the fact that chemistry clubs normally belong to the senior high school where all such club activities tend to be less common than in the junior high school. The remaining 54 of the 79 science clubs treated chemistry in combination with other sciences.

The 155 science clubs were found at random in 32 states and one territory, while the 79 clubs involving chemistry represent 27 states. It is interesting to note that only 8 per cent of the 79 clubs, referred to above, were non-existent, but that 17 per cent of the 76 remaining clubs not involving chemistry were non-existent. It is possible that one of the means whereby successful science clubs may be insured, particularly in the smaller high schools where independent chemistry clubs are impractical, is to include chemistry as one of the subjects treated by the club. This, of course, may be done with or without organizing a definite chemistry section.

Additional statements involving a comparison with the 76 non-chemical clubs are purposely omitted. Specific answers for a number of questions as to the size of the schools and clubs as well as to the time, length and frequency of the meetings, are to be found in Table I. On the basis of school enrolment it will be seen that the average science club, whether devoted to chemistry, completely or in part, is found in a high school of

* The data for this article was collected by the author as Research Associate in the Institute of School Experimentation, Teachers College, Columbia University, New York, N.Y., during the academic year of 1930-1931.

TABLE I
MEMBERSHIP AND MEETINGS

	Independent Chemistry Clubs (25)	Science Clubs with Chemistry as a Combination Factor (54)	Total Science Clubs Involving Chemistry (79)
Average enrolments:			
School	3127	990	1666
Club:			
Boys, No.	29	26	27
%	59	66	64
Girls, No.	20	12	14
%	40	33	35
Totals: No.	49	39	42
Clubs of Boys only	4	10	14
Per cent of Total	16	23	18
Enrolments:			
School:			
Maximum	5500	5500	5500
Minimum	500	32	32
Median	1575	720	1000
Club:			
Maximum	285	126	285
Minimum	10	13	10
Median	29	29	29
Time of meeting:			
In School	9	26	35
After School	8	12	20
Night	3	10	13
Combination	2	3	5
No answers	3	3	6
Length of Meetings:			
Av. No. Minutes	68	55	59
No. of Meetings per Month	2.8	2.8	2.8

NOTE—The numbers in parenthesis appearing under each of the three sub-headings represent the total number of science clubs of the given type.

more than average size. It is equally apparent that successful "combination" science clubs are to be found in schools of less than average enrolment. The fact that successful science clubs of these types are sometimes found in the smaller schools appears to indicate that with the initiative of science teachers and the support of administrators, such clubs could be

much more numerous than at present. Also, from a practical point of view, it appears that in schools of less than 500 students, it is better to have chemistry treated in combination with other sciences, unless the enrolment in the department is above the average or unless the sponsor exercises unusual care to insure the success of the independent club.

The wide range of possibilities within which individual chemistry clubs are operating is found in one club of 285 members representing the departmental roster in a school of more than 1800 students as against another club of 35 members drawn from a school enrolment in excess of 5000 students and representing the entire student body of a four-year high school. Between such extremes there is, undoubtedly, room for the establishment of definite and effective principles for general use, as well as for the qualitative and quantitative determinations of inherent values.

In the mind of the average teacher, whether concerned with science or not, there appears to be relatively few of these accepted principles and determining values.

One of the fairly prevalent ideas, entertained by club sponsors, minimizes or makes more or less unnecessary any activity on the part of the teacher. Adherence to such a policy means a reduction in the possibilities of the club. The end result is an ineffectual organization dissipating the time and energy of the students. Under such circumstances administrators have substituted home-room activities, not necessarily related to science, or have eliminated club work without offering a substitute. In either event, the science teacher is subject to the loss of an important approach to the student body. The fact that sponsors of all other types of the so-called "extra-curricular" activities play an important part, both definite and wise, in directing the organizations appears to reduce the idea of the unimportance of club sponsors to a mere notion. This is not the only ground on which the argument can be met. However fundamental the subject or subjects may be, clubs can not be genuinely and completely successful without sponsors, who through their aggressive interest in the clubs and members are divested with a leadership both democratic and unquestioned.[2] The whole future of the club movement[3] will be determined very largely by the sponsors.

Large club enrolments are not uncommon as is indicated in Table I. This is a point of consequence as long as clubs are considered justifiable in educational activity. It suggests the importance of determining how to maintain successful clubs tending toward the larger rather than toward the smaller memberships.

The suggestions to be found in Table II are of greater value than

TABLE II
PROGRAM AND OTHER ORGANIZATION DATA

	Independent Chemistry Clubs (25)	Science Clubs with Chemistry as a Combination Factor (54)	Total Science Clubs Involving Chemistry (79)
Programs—Typical:			
Business period	9	23	32
Demonstrations	11	24	35
Reports	10	20	30
Speakers	8	16	24
Students	8	10	18
Teachers	1	1	2
Discussion	3	11	14
Competitions	0	2	2
Projects	4	7	11
Issuing bulletin	3	2	5
Visual Aids:			
Films	7	9	16
Slides	1	5	6
Social period:			
Humor	1	0	1
Games	2	1	3
Refreshments	0	3	3
Programs—Special:			
Assembly	3	4	7
Before other Clubs	2	1	3
Benefits	1	1	2
Exhibits	1	3	4
Field and Factory Trips	7	7	14
Home room	0	4	4
Initiatory	0	1	1
Plays	3	3	6
Picnics	2	5	7
Rewards: Service points, etc.	4	5	9
Insignia	7	19	16
Sponsorship:			
Man	16	43	59
Woman	7	6	13
Joint	2	4	6

the factual information, since the sponsors frequently outlined the various types of programs and other activities engaged in by their clubs rather than outlining a typical program. Business periods, for example, are only mentioned in 32 of the 79 cases. These business periods are often reduced to a reading of the minutes. As long as society operates through organiza-

tions in anything like the current practice, it is highly desirable that the business periods become opportunities for learning and practicing the expedient methods at hand. In adding reality to the student's sphere, it is not only possible to prepare him for his future activities in a better way, but it is also possible to insure science of an adequate representation along with other phases of human endeavor.

That teachers rarely appear in the presentation of the programs is quite desirable in the light of modern educational technique. Adult speakers appear to be proportionately too numerous until it is recalled that these figures do not indicate the frequency with which such speakers are employed.

Another healthful sign in program construction is the use of slides and films. Through these aids it is possible to supplement the work of the students in such a way as to make the student feel a greater usefulness to the group of citizens of which he is a member.

It is unlikely that other features of the table will require interpretation.

The chemistry teachers, who have contributed data for this report are to be congratulated for the record which they have made possible. It is hoped that they, together with other science teachers, will contribute to further studies of this sort in greater proportions, to the end that factual information benefiting all may be had at the most economical figures. Through such action, the technique of science teaching, including guidance in science through club sponsorships, may continue to advance.

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An Auditorium Program—Shadow Pictures from the Life of Louis Pasteur

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A ninth grade home room group, asked to give an auditorium program, decided to relate it to their work in general science. A shadow program was decided upon and as the life of Louis Pasteur offered incidents that lent themselves to picturization, Louis Pasteur was chosen as the subject. His story as told in Paul de Kruif's *Microbe Hunters* was told to the class and, from this and some additional material, the class selected ten incidents they wished to portray and decided upon the manner of portrayal. Pupils were chosen to prepare stories to precede each picture and the play was ready for rehearsal.

The shadows were thrown on an 8 by 12 foot muslin screen by a lamp at the rear of the stage. A lantern placed in front of the screen was used to project the cast of characters, various acknowledgments, songs, and the titles of the different pictures. The time required by this program was thirty-five minutes.

After the preliminary slides were shown, this song by the audience to the tune of Yankee Doodle introduced the story:

Louis Pasteur

When folks were ill long years ago,
They didn't know the reason;
They thought 'twas evil spells that worked
Both in and out of season.
But now we know this is not so,
Of this we bring you tidings;
For deadly microbes work us woe,
We find them where they're hiding.

In France there lived a man, Pasteur,
His duty never shirking,
He studied germs, he learned their ways,
Where'er he found them lurking.
He saw them with his microscope,
And soon he learned their habits;
He watched them do their evil work
On guinea pigs and rabbits.

He said, "Your charms don't do you good
Nor do your quacks and potions,
Your witches and your witches' spells
You'll find are silly notions.

If you would live full threescore ten,
In hale and hearty fashion,
You'll have to learn to tame the germ,
And make health rules your passion."

Brief summaries of the introductory stories and suggestions for the pictures follow:

Story I. October 1831. A blacksmith in the French village of Arbois is burning the wounds of the farmer, Nicole, who has been bitten by a mad wolf. Louis Pasteur, a boy of nine, curious but fearful, joins the crowd in front of the blacksmith shop. The smith, iron in hand, appears at the door and explains the plight of Nicole.

Picture I. (The story suggests the action of this picture.)

Story II. Pasteur attends school in Paris. He becomes interested in science and spends much of his time experimenting with microscopes in the laboratory of his chemistry professor, Dumas.

Picture II. Louis Pasteur and several schoolmates are grouped about a laboratory table absorbed in work with microscopes.

Story III. Pasteur experiments with different types of spoiled wine and finds the bacteria responsible for the spoiling. He is visited by French wine-tasters who bring him samples of bad wines so that he might make a diagnosis. Without tasting the wine, but with the help of the microscope, he names the bitter, or sour, or ropy samples correctly. He teaches the wine-makers pasteurization, which process, since applied to milk, has saved countless lives.

Picture III. The wine-tasters visit Pasteur. He and his assistants examine samples of wine. (Imitation slides prepared from panes of glass, paste, and paper cut-outs held close to the screen, show the audience what the microscopes reveal. Many textbooks in biology picture the organisms found in diseased wine.)

Story IV. The Pasteurs are visited by Professor Dumas, Pasteur's old chemistry professor. Dumas describes the ravages of the silk worm disease in southern France and asks the assistance of Pasteur in combating the disease.

Picture IV. (The story suggests the action of this picture.)

Story V. The Pasteurs, assistants, and microscopes move to southern France where months are spent in the study of the silk worm and its ailments. The cause and the remedy are finally found. Pasteur questions—Are many diseases of living creatures caused by microscopic organisms?

Picture V. Pasteur and his assistants study the silk moth and its life history. (If specimens are not available, cut-out forms make satisfactory shadows on the screen.)

STORY VI. Pasteur and his assistants experiment with rabbits, guinea pigs, chickens, and mice to find the murderous microbes that cause disease. They make the wonderful discovery that germs can be used to combat germs.

PICTURE VI. On the laboratory table are cages of available live animals which are handled and examined. (Animals and imaginative students will supply plenty of action for this picture.)

STORY VII. In Pasteur's animal pens are dogs that are howling mad. While two servants pry open the jaws of a powerful bulldog, Pasteur sucks up some of the froth from its mouth to get a specimen in which to search for the microbe of hydrophobia. They learn how to weaken the hydrophobia microbe so that, when injected into the bodies of dogs and rabbits, it protects them from the disease.

PICTURE VII. Two servants bring a dog into the laboratory where the action described in the story takes place.

STORY VIII. Mrs. Meister from Alsace brings her little boy, Joseph, to Pasteur. Joseph has been bitten by a mad dog. "Save my little boy!" the mother begs. On the night of July 6, 1885, on the advice of two Paris doctors, is made the first injection of weakened hydrophobia microbes into the body of a human being.

PICTURE VIII. Mrs. Meister and Joseph enter the laboratory where the action suggested in the story takes place. Pasteur assures the mother that the child will receive treatment.

STORY IX. Joseph Meister is saved. From many countries come letters and telegrams to Pasteur—admiring letters, frantic letters, from doctors and fathers and mothers.

PICTURE IX. Pasteur is seated reading. The postman enters, salutes, delivers packets of mail, salutes and retires.

STORY X. All the world honors the memory of Louis Pasteur. The Institute Pasteur in Paris carries on the work that he started. For long years Joseph Meister stood at the gate of the Institute, a living testimony to the great service of a great scientist to humanity.

PICTURE X. Pasteur occupies the center of the picture. A boy and girl at either side stand at salute.

The last verse of the song to Louis Pasteur closes the program:

Pasteur has lived that all of us
Might safer be in living;
To him we sing in grateful strain,
To him we're honor bringing.
Hurrah for eyes that see the truth!
Hurrah for tongues that tell it!
Hurrah for hands that do its work!
For nothing can excel it.

Projects and Principles of Science

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"We learn by doing" is a trite and true saying yet one that, in the philosophy of science teaching, has often been misinterpreted and has been used as the justification for much malpractice. We learn to do by doing only those things we do. One does not learn to make bread by operating a typewriter nor does he learn science by bending glass tubing or making "plasticine" models of a frog.

Many of the things done in science teaching under the caption of "projects" are merely busy work which may provide things for idle hands to do and so keep them out of worse mischief, but as a means of science instruction they are often a delusion and a snare.

"The purpose of science teaching in all grades of schools is not chiefly to impart knowledge of subject-matter but to train persons in the methods of the masters, which is invariably the *project method*."[1]

Can you imagine Pasteur when trying to find a method of preventing chicken cholera, contenting himself with making a clay model of a chicken, or Edison, when trying to discover what organic fiber would, when charred, make the best carbon filament, being satisfied by making a collection of such fibers, each properly labelled?

What then is the method of the scientist? It is the problem method. Always the scientist works to solve a problem. He must first be aware of a problematic situation and he must define that problem clearly in order to tackle its solution intelligently.

His problems are of two kinds. First, he may be trying to discover an orderly sequence in nature, usually a cause and effect relationship. When that relationship is discovered it is stated as a law. So Galileo by his famous experiment at the leaning tower of Pisa not only refuted Aristotle's statement that a ten pound shot falls ten times as fast as a one pound shot but he noticed, since his attention was fixed on the rate of fall, that the objects dropped gained in speed the longer they traveled. Then he wondered if this acceleration was accomplished in some orderly fashion, if there was a law for such phenomena. He used an inclined plane to slow down the rate of fall so he could time it more accurately and discovered, after repeated experiments, that if a body falls a certain distance in the first time interval, it falls four times as far (2^2) in two time intervals, eight times as far (2^3) in the three time intervals, etc.

Second, the scientist may be trying to discover how some known law can be used to solve his problematic situation. Thus Watt, faced with the task of improving the crude steam engine of his day, found that one of his problems was the discovery of some device that would prevent the engine from racing as the pressure in the boiler increased or from slowing down so it would not do its work as the steam pressure fell. He was trying to think of some law that he could apply in a contrivance that would accomplish this thing. He searched in his mind for many months, recalling this law and that law before he finally thought of one that might work, the law of centrifugal force. This law states that the more rapidly an object rotates about a center the stronger is its tendency to fly away from that center. Then he devised the "governor." Two iron balls were carried at opposite corners of a jointed quadrilateral frame. The other two corners were attached by joints to an upright axle, the lower corner fastening to a movable ring. Now as the engine began to race, the axle of the governor, geared to the engine's shaft, turned more rapidly, the iron balls swung out farther from the shaft, the ring moved up on the shaft and by an iron rod attached to it, the steam valve was partly closed. So the supply of steam to the cylinder was reduced and the engine slowed down.

Science today embodies (1) all those laws that have been discovered by scientists and (2) the method of careful reflective thinking that scientists have used in their processes of problem solving.

This body of knowledge and this method have been of immense service to man in satisfying his curiosity and in ridding him of baseless fears and in giving him an increasing mastery over the phenomena and forces of his environment so that he lives more healthfully, produces goods more abundantly, and enjoys more comforts and luxuries than ever before.

It is the task of the science teacher to impart an ability to use those laws of science that are of most importance to his pupils in solving the problems involving science that commonly arise in life situations, to give them skill in the use of the scientific method and a realization of its importance.

The things that pupils should be doing in order to acquire skill in their doing are (1) solving life problems that involve the application of the most practical of the laws of science, (2) gaining acquaintance, through conscious and frequent use, with the elements and safeguards of scientific thinking, and (3) possibly for the more promising pupils, acquiring experience in original discovery as a test of aptitude for research in science. Let the teacher evaluate the effectiveness of his instruction by these criteria: (1) Are my pupils constantly gaining proficiency in applying the laws of

science to the problems with which they are faced? (2) Are they daily gaining skill in scientific thinking? (3) Are they more and more acquiring the ideals, the desires, and the attitudes of mind that have marked the great scientists?

It is evidently imperative that the problems which pupils are led to undertake be selected with care. Each group should eventuate in an understanding of some important principle or several closely related principles. Thus the teacher may lead pupils to realize how very remarkable it is that trees, shrubs, and herbs are all green. The fact is so commonplace that our wonder at it has become dulled. Why are they not all yellow or purple? Pupils can be led to see a real problem here and one that appeals to their innate curiosity.

Started on the quest of an answer to the puzzle, pupils will acquire the needed facts, not as so much material to be memorized but as data needed in chasing down the solution of an enigma. That is characteristic of the scientist. On the trail of a problem he scents out those facts that lead him forward. He does not gormandize a book full of miscellaneous information.

Ultimately pupils arrive at an understanding of the principle of photosynthesis, namely, that this green chlorophyll is well-nigh universal in plants because it is unique in being able to transform the energy of the sunlight into a form that can, in the living cell, shake apart the elements in carbon dioxide, water, and the nitrates and recombine them to form such plant foods as sugar, starch, etc.

When once this is clear, then come many more problematic situations to impart facility in the application of the principle. How then do plants that are not green, like molds and mushrooms, obtain their food? Why is a greater tonnage of fish caught on the Newfoundland banks in seasons with many sunshiny days than in cloudy seasons? Why does the market gardener leave the tops of the celery plants uncovered when he banks the growing stalks to bleach them?

Throughout the supervision of the study that is being done by pupils, the teacher must see to it that they are thinking well and clearly. Are they selecting only such facts as are pertinent to the problem in hand? Are the data collected arranged in logical sequence so as to point to a conclusion? Are the experiments used in the study so conducted that only one variable is permitted, the one supposedly acting as the cause, the effect of which it is desired to know? Pupils need not only to be habituated to exact reflective thinking; they must be made aware of the elements of the process, conscious of skill in their use, and alert to the errors into which

they are most likely to fall. Surely if any teacher is to feel the responsibility for developing skill in scientific thinking it should be the science teacher.

Judged by the criteria suggested above much of the science teaching in our public schools is woefully bad. Pupils are forcibly fed on a mass of, to them, needless and uninteresting facts; they are tested on purely memoriter material. They go out into life scarcely one whit better able to understand or control their scientific environment, with no conception of what constitutes good scientific thinking, much less any skill in the process. Fortunately there is considerable excellent teaching of science, judged by the criteria enumerated. May it speedily leaven the whole mass!

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Schools in the Delaware Valley Plan Living Memorials to William Penn

Edward E. Wildman
Director of Science Education, Philadelphia,
Chairman, William Penn Planning Committee

The year 1932 is a major anniversary year in America. Not only is it the bicentennial of the birth of Washington, but it is also the 250th anniversary of the coming of Penn to America. Here he established in his province his "holy experiment" in government based on social coöperation. Washington and his fellow patriots built an independent nation upon these principles of civil and religious liberty a century later, and it was in Penn's Delaware Valley that our nation had its birth.

Officials of schools of all types in the Delaware Watershed—public, private, and parochial—have decided that it would be wise to plan for living and continuous memorials to Penn in view of his great contribution to government, not only here in America but recognized increasingly throughout the world.

At a conference of these school officials held at the University of Pennsylvania in March 1931 during Schoolmen's Week, Dr. Edwin C. Broome, Superintendent of Schools of Philadelphia proposed the following plans:

First, that we locate as many trees as possible, still growing in the Valley which were growing when Penn came, secure seedlings from these and plant them in public parks near the schools where they will have perpetual care, and mark them as Penn Memorial Trees, with the name of the school planting them and the date.

Second, that we make a study of our local natural history, including plant and animal life, mineral and fossil deposits, giving especial attention to distributional limits of Canadian and Carolinian forms over our Piedmont and Coastal Plain regions, in honor of Penn's great interest in natural history and his repeated suggestions that children and youth be given the opportunity to enrich their lives by its study.[1]

Third, that we support local borough, county, city, and state efforts to set aside parks and wild life sanctuaries, such as forest and game reserves while they are still available in our rapidly growing urban region which is now under study by the Tri-State Regional Planning Commission; such reservations to be known as Penn Memorial Reserves.

Fourth, that the safety of all who wish to study nature afield be insured by laying out hiking trails on either side of the river from the Water Gap to the sea; these to follow, wherever possible, the lines of Indian trails and roads built in Colonial times; that these trails be known as Penn Memorial Hiking Trails.

Fifth, that we study the Indian life of Penn's day and his care for the respect of their rights; also our government's present Indian policy now under study and revision by officials of the Indian Bureau, who in a very real sense are restating Penn's pledge of trust with the Indians.

These plans were approved and the appointment of a planning committee was authorized. This Committee has functioned during the year, and at the coming meeting of a Schoolmen's Week Conference will make its report.

More than forty "Penn Trees," actual survivors of Penn's Woods, have been found, and seedlings are started. More than fifty miles of hiking trail have been designated, and other sections totaling as much more are available through publicly owned lands. A part of one of these trails follows an old Indian trail along which flints have been found recently. It also follows a road laid out by one of Penn's surveyors, and crosses a section of the valley so rich in minerals that Professor Dana called it the "Switzerland of America." Many of the types described in his *Mineralogy* came from this region.

At a meeting of the Committee in the autumn another project was proposed and approved. This is unique. It is suggested that on the night of October 24, the date chosen for the official celebration of the coming of Penn, the light of a star which left it in approximately the year 1682 and which is just now reaching the earth be transformed into electrical energy and used to illuminate, by radio, portraits of Penn in Christ Church Common in Oxford, England, and in Philadelphia at the same moment. Members of the Franklin Institute have agreed to do this.

The Planning Committee wishes to acknowledge with great appreciation the fine coöperation of many interested individuals who are in schools and of others who are not.

It is hoped that the report of the committee including a field map of the region can be published in pamphlet form for the use of teachers by April 1, and that its cost will not exceed fifteen cents.

The first four of the plans suggested above will be expanded later under the title "Out of Doors in the Delaware Valley" with sectional field maps and illustrations.

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Visual Aids—of What Worth?

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Educational practice is determined largely by the results of careful research. Some of this research has produced interesting results in the field of visual aids. For example, an experiment has been performed in one of Cleveland's larger junior high schools with the object of obtaining evidence as to the value of visual education in the curriculum.

Although much has been said on both sides of this question yet very little objective evidence has been brought forth to substantiate the claims of the dubious or the optimistic. Possibly the reason for so little evidence lies in the difficulties surrounding the equating of the factors necessary to setting up such an experiment.

This article aims to advance experimental proof that the use of visual aids is of more than theoretical value. In order to do this it is necessary first to show that as many factors as possible in the set-up of the experiment were equated, and second, to interpret the data discovered at the conclusion of the work.

Visual education in the last ten years has gained in favor and in practical use but more so in favor than in practice. This situation is due partly to lack of funds in some cases and partly to insufficiency of proof as to the value of visual aids. Practically, the use of these aids is easily adjusted to teaching method so as to make the subject matter more vital, the motivating appeal to the child more valuable and a certain "clinching" power through the eye certain to supplement the knowledge which enters through the other channels of learning. Therefore, to add encouragement and proof of value to those contemplating the introduction or more extended use of visual aids the following experiment was set up.

Formation of Groups

Two full classes of ninth-grade students in general science were selected as subjects for the experiment. They were chosen from two consecutive sections of average P.L.R. (a term similar to I.Q. but obtained through a group test) and scheduled for the following semester to recite in the morning at adjoining periods with the same teacher. The purpose of this

arrangement was to set up the best teaching conditions possible to equate the factor of fatigue for pupils and teacher as well as to make it easier for the teacher to present exactly the same material to each class.

Since this experiment had to be scientifically evaluated the contributing factors involved in setting up the conditions were carefully equated so far as possible. In addition to this, it was necessary to properly test the results at the conclusion of the experiment. This latter task was lightened by the interest taken in the problem by the Bureau of Educational Research connected with the Cleveland Public Schools.

The balancing of the factors necessary to obtain two well equalized groups was not attempted until after the first four weeks of teaching. This delay gave the teacher an insight into the pupil's achievement in general science and enabled him to break up any possible tendency toward the formation of a class spirit or morale which might introduce an error into the final test results. Up to this time both groups had been taught identical subject matter.

The next move was to pair individuals in the classes in order to equalize the two groups into a control group and an experimental group. The experimental group was the one to receive the benefits of the visual aids while the control group did not. The following factors were taken into consideration: P.L.R., previous class achievement, sex, chronological age, and of course the teacher and class schedule.

According to sex the ratio of the boys to the girls was nineteen to eleven in both groups. This pairing by sex was designed to equate the factor derived from the fact that in the natural science groups boys have been found to show a significant achievement difference over the girls.[1]

According to P.L.R. the maximum difference allowed between the two classes was not more than three points on the pairs. The average P.L.R. of the control group was 100.8 and that of the experimental group was 100.4.

Chronological ages of both boys and girls were paired so that a difference of not more than one year was allowed. The average chronological age of the boys was almost equal to that of the girls.

Previous class achievement was easily taken into consideration through the administrative device of waiting until the end of the first four-week period before forming the two groups for the experiment.

Since the teacher was the same for both classes and the pupils were paired as above the teaching methods were the only factors left to be properly equated. Neither class was told that this work was to make a showing for experimental results. No explanation, therefore, was offered to them as to why one group saw visual aids while the other did not.

Procedure

The plan of teaching called for the presentation to the experimental group of the regular subject matter in general science plus all the visual aid in slides, movies, models, and exhibits obtainable from the educational museum. The control group was taught identical subject matter but the visual aids were withheld. For instance, the experimental group was assigned textbook study and had class discussion on the topic of sewage disposal which was a unit of work under the larger unit—*Water*. At the proper time slides, movies, and mounted pictures were introduced to motivate or supplement the topic, depending upon the suitability of the material. In the control group the same assignments were given and discussion held, but instead of using visual aids the teacher tried to give as clear a description or conception of the visual aids as possible. The result was that one group saw a picture on sewage disposal during which the teacher explained to it the operation of an Imhoff sewage digestion tank, and the control group had to build up a conception of this piece of apparatus from an oral description given to the best of the teacher's ability.

The class work during the experiment was divided into major topics on air, heat, and water, with tests given at the conclusion of each topic. Some of the visual aids were especially adapted to these topics and, therefore, made good experimental material. The tests were of the new type and were made out by the head of the science department for all classes. They contained certain questions dealing with the use of visual aids as well as questions testing for the mastery of the core material of each topic. Three of these tests were given during the experiment, one at the close of each major unit of work. The content of the tests was in each case concealed from the class teacher to avoid danger of bias.

In order to test for any special achievement which might be attributed to the use of the visual aids themselves, a special test, no part of which was known to the class teacher, was devised through the help of the department of educational research. This test was in three parts: a vocabulary test, a completion test, and a reasoning test which attempted to test for logical thinking on the visual aids. For instance, the pupil was required to study a group of mixed related ideas, then to cross out one which was included but unrelated to the scientific conception. He next had to select a title, arrange the remainder of the phrases in their natural scientific order, and then draw arrows in a diagram to indicate this natural order. Possibly an illustration will make this clear:

(a) dissolved organic material *(b)* how living organisms help to purify sewage *(c)* they are eaten by fish *(d)* is "eaten" by bacteria *(e)* removal of sludge *(f)* they are eaten by water fleas *(g)* eaten by protozoa.

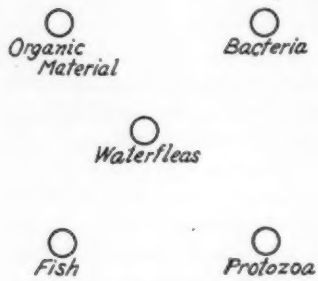

Figure 1.—The diagram in blank form

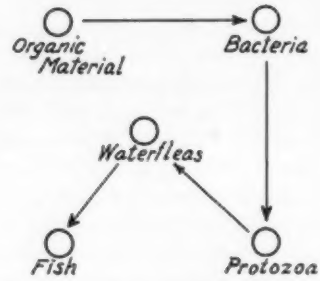

Figure 2.—The diagram properly completed

In this test item the pupil should cross out "removal of sludge"; then arrange the remainder of phrases in the order *b, a, d, g, f,* and *c;* then complete the diagram as shown in Figures 1 and 2. This type of question requires that the pupil must know the logical order of operations to form a clear conception of the scientific idea.

Interpretation of Evidence

Table I lists the names of the topics tested and shows comparative median scores for the control and experimental groups. It will be noticed that small differences in median score were each time in favor of the experimental group.

Table I

Median Scores by Control and Experimental Groups

Topic	Control Group	Experimental Group
Air	34.5	37.33
Heat	41.5	47.75
Water	23.0	25.5
Special	11.14	12.17 (Arithmetical mean)

To make certain that the differences given in Table I were scientifically significant, two of them were chosen and statistical procedure applied. The method employed was that of differences of means resulting in a critical ratio. The differences in arithmetical means found from the individual scores on the heat test and special test were used in making up Table II.

An examination of Table II shows that the critical ratio of 3.12 found for the heat test in favor of the experimental group is undoubtedly signifi-

TABLE II

DIFFERENCES IN THE ACHIEVEMENTS OF THE CONTROL AND EXPERIMENTAL GROUPS IN GENERAL SCIENCE PAIRED ACCORDING TO (1) PREVIOUS CLASS ACHIEVEMENT (2) P.L.R. (3) SEX (4) CHRONOLOGICAL AGE (5) TEACHER AND CLASS.

Test	Subject and Group	No. of cases	Arithmetic Mean*	Standard deviation	P.E. of Mean*	Difference of M.*	P.E. of diff. Mean*	Critical Ratio	Interpretation
Heat	Gen. Science Experimental Group	27	47.22	8.71	1.13	5.48	1.758	3.12	Significant
Test	Control Group	27	41.74	10.38	1.347				
Special	Experimental Group	29	12.17	4.40	.551	1.03	.773	1.33	Of Some Significance
Test	Control Group	29	11.14	4.336	.543				

* Arithmetical Mean or Average Score.
Formulas used in the above computations.

A. $SD = \sqrt{\frac{\Sigma d^2}{N}}$

B. $\text{P.E. of the Mean} = \frac{SD}{\sqrt{N}} \times .6745$

C. $\text{P.E. of Difference of the Means} = \sqrt{\underset{\text{of Control Group}}{(\text{P.E. of Mean})^2} + \underset{\text{of Experimental Group}}{(\text{P.E. of Mean})^2}}$

D. The Critical Ratio = The difference of the means divided by the probable error of the difference of the means. A critical ratio of more than 3 is regarded as significant.

cant especially in the light of the care taken to equate as many factors as possible in the experiment.

The critical ratio of 1.33 found for the special test indicates that the smaller difference in arithmetical means of the two classes is nevertheless significant from a practical standpoint if not statistically so. That is, the small size of N, or the number tested, exerts a great influence upon small differences throughout the statistical procedure.

It is possible to explain the small difference in arithmetical means on the special test partly on the basis that the teacher was able to describe to the control group the conceptions connected with machines, processes or principles found in the visual material more successfully than was anticipated.

Finally, it is of decided significance that there is a definite central tendency in the results of *every* test shown in Table I in favor of the experimental group.

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EDITOR'S NOTE: *Reference to the outline of divisions of this bibliography given on page 56 of the October issue, will show that, in the last division, it was intended to list reports of committees relating to science education. The list of such reports is too long to be included here. It will, therefore, be published in a later issue of the journal as a separate bibliography.*

The October, 1932, issue will contain a supplement to the bibliography presented in the first four numbers of Volume 16. The supplement will list investigations completed and published during the interval from June, 1931, to June, 1932. It is our plan to maintain this bibliographic service annually as a feature of the journal.

A Symposium on the Thirty-First Yearbook of the National Society for the Study of Education, Part I, Entitled, "A Program for Science Teaching"

EDITOR'S NOTE: *Following the joint meeting of the National Association for Research in Science Teaching and the National Society for the Study of Education, at which the* Thirty-First Yearbook, Part I, *was presented, the editor had numerous requests to provide space in the journal for a symposium on the* Yearbook. *In keeping with these requests the following symposium is presented.*

It is hoped that readers of SCIENCE EDUCATION *may feel disposed to submit to the editor further comments on the* Yearbook. *Should sufficient commentaries be received, space will be given in a later issue to a second symposium. It is especially desired that classroom teachers of science send their reactions to the* Yearbook *for inclusion among the later comments.*

Comments on the Program for Teaching Science from the Psychological Point of View

In my remarks printed in Chapter XVIII of the Yearbook I have commented favorably on two of the general features of the Committee's program, namely, the system and unity of the plan, and the prominence which is given to the process of generalization in the study of science. No program which does not provide a progressive sequence of study from the first grade to the twelfth will meet the needs of American schools, and no program which does not emphasize the process of generalizing from experience can be called a program in science. The Committee has, therefore, struck the proper keynote.

Having struck the keynote the Committee does not pretend to have worked out the entire composition. Much remains to be done. I shall indicate in a few words what I conceive to be the most important features of the remainder of the task.

The Committee has set the same general objectives for the entire twelve grades. These consist tentatively of some thirty-eight generalizations (pp. 53-55). That these generalizations are intended to serve as objectives at the various levels is shown by the fact that certain of them are repeated in the outlines of the work designed for the various grade levels. That is, the plan is not that certain generalizations shall be arrived at in one grade and others in other grades, but that given generalizations shall be set as objectives continuously throughout the school. That is, the child shall be learning that *the sun is the chief source of energy for the earth* in every grade from the first to the twelfth.

Now obviously this presents a problem. The Committee evidently holds that there are degrees in the recognition of such a principle as this. The plan assumes that it would be incorrect to say that a child either grasps such a principle or does not grasp it. It is inconsistent with the mastery principle, so far as scientific study is concerned. The pupil's apprehension of a principle may be gradual and progressive.

I am not quarreling with this assumption, but I should like to make two points concerning it. First, we should be perfectly clear that this assumption underlies the Committee's program and that it is contrary to a rather widely accepted theory of education. Second, it is not sufficient to lay down the general principle. It is necessary to work it out in detail. This detail, let me add, must be worked out before the plan can be put into operation by teachers in general. Otherwise very serious confusion will arise in the practice at successive grade levels. The natural implication of the report is that the various principles shall be explicitly stated in the course of the instruction at the successive grade levels. If this is done, some way will have to be found to make it appear that the later treatment of a generalization really adds something to the earlier treatment and is not mere idle repetition. It will be necessary, also, to guard carefully against the danger of verbalism.

Another question is more fundamental. The Committee concludes from current psychological theory that the child's mental development is gradual rather than saltatory. From this it concludes a somewhat different principle, namely, that the child's mental operations are the same at various ages and that, therefore, the kind of scientific study which is appropriate is precisely the same at all ages. In other words, generalizing should occupy as prominent a place in the study which the young child makes of the phenomena of the world about him as it does in the study carried on by older persons. I am not at all sure that this is the case. At any rate I do not believe we have enough evidence to make us sure of this sweeping conclusion. To the young child phenomena may be more nearly just phenomena—happenings. There may be more place for the wide-eyed watching of the drama of life without for the moment inquiring too deeply into its explanation. There is a tendency for casual observation to become weaker as intensive, systematic observation becomes stronger. May more or less casual observation not have a function in providing the child with a rich background of experience for the later more intensive study of particular problems and the search for explanatory generalizations?

I would not be dogmatic on this point. But neither do I think one who believes that the emphasis should not change should be dogmatic. I do

not know of any direct or conclusive evidence that there should be no change in emphasis. The mere fact that children can reason and that their general intellectual competence increases steadily rather than by sudden leaps does not in itself prove the correctness of this rather specific contention. The truth or falsity of these two points of view would have to be arrived at by more detailed and direct study of children's mental processes and by an investigation of the results of various methods of handling the subject.

The psychology of a school subject should not be thought of as merely an attempt to apply deductively certain general conceptions derived from studies of mental development and learning. The newer psychology of the school subjects is not content with such deductive application but attacks directly the problems of learning in the subject by methods adapted to the study of these particular problems. Such direct study has contributed materially to our knowledge of learning in the subjects of reading, writing, and arithmetic, and this knowledge has been very influential in the organization of the curriculum and the determination of methods in these subjects. The same kind of direct study will doubtless prove equally productive in the study of the curriculum and methods in the other subjects, including science.

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Some Practical Aspects of the Committee's Program for Science

Twenty-eight years ago Jackman advocated a science program in which "every step taken should be a substantial preparation for the next throughout the course from the kindergarten to the university."[1] In large measure the Thirty-First Yearbook Committee has realized Jackman's dream, has outlined a program developing grade by grade from kindergarten through the senior high school.

The program for grades one to six includes the best of the nature study movement, and the scientific foundations of individual and social health. The program for grades seven to nine expands the work heretofore known as general science into a three-year program, related to the elementary school on the one hand and to the senior high school on the other. For the senior high school the Committee's program is not quite so clear, yet, it proposes building on the nine-year foundation two two-year science sequences—one biological, the other physical. The Committee recognizes that some schools may wish to offer half-year or one-year electives in such spe-

cial fields as astronomy, physiography, geology, botany, zoölogy; and it implies at least, that the average senior high school of grades ten to twelve may properly require only one of these sequences or one entire sequence and half of the other.

Superintendents, principals and other supervisory officers will welcome the practical adjustments which the Committee proposes to the administrative problems involved in a science program.

1. For the elementary school the Committee leans toward a special time schedule for science rather than a curriculum organized on the activity basis. Yet, the program proposed is equally adaptable to either type of elementary school organization.

2. In junior high school, the program fits equally well schools organized on the 8-4, the 6-3-3, or the 6-6 basis.

3. In both junior and senior high school, the Committee would abandon the double laboratory period—a boon to all program-makers.

4. Placing the science work toward the close of the day in those schools where it will be scheduled on a time basis, facilitates the use of museums and excursions.

5. Until further evidence is available, the Committee favors the teacher-demonstration and group-experimentation methods; both procedures tend to lessen the cost of science instruction.

6. The chapter on "science rooms and their equipment" will be useful to administrators, architects and others responsible for planning and providing space for science instruction.

The most practical value of the Yearbook lies in its contribution of suggestive material and method to science curriculum builders. A partial list of these suggestions follows:

a. A list of 38 principles or generalizations suggested for guidance in the selection of specific objectives of science teaching (pp. 53-55);

b. Curtis' "outline of scientific attitudes" to be developed (p. 56);

c. Criteria for selection of objectives for the elementary school program (pp. 134-143);

d. An analysis of techniques to determine content (pp. 171-175);

e. Suggested content for the grades of the elementary school (Chapter XII);

f. Suggestions for building a course of study in science for junior high schools (Chapter XIII);

g. A list of nine principles of biology to determine knowledge content based upon objective evidence of the life needs of the average person (pp. 224-226);

h. A list of twelve significant trends in the physical sciences and a series of objectives for high school physics and high school chemistry (p. 269-).

As pointed out in the Yearbook, pages 354-359, the Committee recorded a large number of problems and questions needing further investigation. In addition, the report raises other questions in the reader's mind. Here are a few:

1. The Committee has made no adequate differentiation between the content for the elementary and the junior high school levels. This problem needs to be solved if we are to have an effective program running from the kindergarten to college.

2. Chapters on the elementary school emphasize content objectives stated in the form of simple declarative sentences. Unless the teacher is thoroughly conversant with the philosophy of education underlying this program she will be apt to use this type of syllabus much as she would a topical outline.

3. The chapter on the preparation of teachers for science teaching can be carried into effect only through a four-year curriculum for the preparation of elementary school teachers.

4. In many respects the science program outlined by the Committee overlaps the work now offered in the social studies and under the general caption of health. These issues will have to be adjusted.

5. The Committee pointed out the misadjustments between high school and college science; yet it took no position whatsoever as to the responsibility of either group for helping solve the problem. Unless the young man or woman who completes a two-year sequence in either physical or biological science has a material advantage when he enters college over the student who has not had such a science course, our high schools had better forever abandon their claim to preparing youth for college.

In its emphasis upon basic ideas or concepts as the foundation for a science syllabus the Committee has made its most practical contribution. Reference to three of these indicate the importance of this part of the report:

1. A science program should consist of a series of experiences that will gradually modify the individual's attitude, knowledge and adaptation to the scientific phenomena about him.

2. Science instruction should be organized about those basic concepts or truths that determine man's adaptation to his environment.

3. The child's interest in, and comprehension of, phenomena, facts and causal relationships is a proper basis for curriculum building.

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The Relation of the Committee's Report for Science Teaching to the Nature Movement

The recommendations of the Committee will help the nature movement greatly by focusing attention of school people on the desirability of more work in the general field of science in elementary and secondary schools. Such a service is to be commended if that attention results in a critical examination of the proposals and an evaluation of them in terms of the common objectives of nature study and elementary science providing a real difference exists between the two.

The program is sufficiently definite to be open to specific analysis and will arouse discussion because of this. This should open the way for improvement which in the long run will influence the nature movement and enter into the practices of science or nature teaching whether this is in accord with the recommendations of the Committee or not. If instead of being so analyzed and improved, the program is accepted as a fundamentalist accepts his Bible, it will undoubtedly delay progress in science teaching and cause those identified with the preparation of science teachers and the formulation of nature and science programs justly to lose standing with workers in the field of pure science and in the philosophy of education. If also, the Yearbook results in the production of similar pieces of work by the same methods involved in the preparation of the present study, progress in the general field of teaching people to learn from their immediate environment will be further delayed and literature will continue to be clogged with unreliable reference material.

In my judgment there is so little fundamental difference between what constitutes good nature study and good science teaching below the college level that any criticism of the program must necessarily involve an evaluation of its influence on both. If one designates good elementary and secondary school science as lacking in the spirit which has been so conspicuous in the best work thought of as being nature study, or designates as good nature study material which lacks the fundamental honesty which

characterizes good elementary and secondary school science, then there might be reason for starting an argument. I, for one, do not draw the distinction implied above. Because of this I can accept little of the criticism of nature study made in Chapter II, and I feel with M. A. Bigelow of Columbia that if it is the judgment of the Committee that nature study is as represented in that chapter prepared by its chairman, then it is unfortunate that the report gives the impression of being authoritative without being that. It seems almost impossible to imagine one well versed in the nature movement making many of the statements and implications to be found in Chapter II.

When one compares Chapter II with the later chapters by Dr. Billig and Dr. Craig, he finds it difficult to recognize a unanimity of opinion of the Committee as to what constitutes nature study. Basing my judgment on correspondence, conversation with the members of the Committee, and the printed statements which appear in the galley proof and in the final report, I am convinced that the report is not representative of the convictions even of the members of the Committee as a whole.

Any attempt to predict the effect of the Yearbook on the nature movement then would depend upon the sections of the report which happen to get the most widespread recognition. If some of the statements of Craig and Billig get recognition, the movement will be helped. If some by Powers get support, the movement will be compelled to defend itself. It will be perfectly able to do this effectively if given the opportunity. One can almost say that no matter what objection one might make to the program based upon statements found there, the Committee can point to other statements elsewhere in the report which may offer a contradictory interpretation. This was, I think, evidenced by the interpretation made at the meetings by Dr. Carpenter of the high school science offerings, and the ease with which the Committee pointed out a different interpretation to be found elsewhere.

The program possesses a number of weaknesses not characteristic of the nature movement which I doubt would have appeared had it been prepared by such nature leaders as Comstock, Bailey, and Bigelow. Should these weaknesses gain unwarranted recognition and should they persist in subsequent reports, the nature movement would lose ground. I refer specifically to the following weaknesses among others:

1. Repeated reference to printed authority as authoritative without recommending first exhausting the possibilities of first-hand experience, particularly in the lower grades;

2. Lack of vision, logic, and organization in the selection of the admittedly inadequate thirty-eight principles and generalizations appearing in Chapter IV;

3. The drawing of generalizations such as some in Chapter II without adequate and accurate supporting data;

4. The repeated use as authoritative of studies whose validity can be seriously questioned and the persistence in keeping these studies in literature thereby complicating the problem of the layman who has the right to look to the Yearbook for authoritative help. (There are at least fourteen references to two invalid studies or to studies based upon these);

5. The failure to differentiate between the nature of the offerings at the various grade levels as pointed out by Dr. Freeman in his commentary;

6. The naïve idea that average teachers will use the principals and generalizations which appear as declarative sentences in any other way than the way they have taught, almost by rote, much factual material presented outside the field of natural science;

7. The repeated assertion that the program bears the unanimous approval of all members of the Committee in the face of repeated inconsistencies and the implication which this makes that the program is representative and possibly generally supported in all details by leaders in the field. (I know from having read the galley proof and the final report that in a number of cases the statements of the final report are contradictory to statements which appeared in the galley and which seemed more truly representative of certain members of the Committee.);

8. The inadequate treatment of the problem of teacher-training with abundant evidence that there was little mastery of the published studies which have important bearings on the subject. (In this connection I do not refer to my own studies on this subject.);

9. Failure to recognize as has the nature movement the value of encouraging a type of popular education about nature. In more recent times this function carried by the earlier nature publications has been adequately care for by the American Nature Association, publishers of *Nature Magazine* and The National Geographic Society, publishers of the *National Geographic Magazine;*

10. The lack of courage shown by the apparent refusal of the Committee to deal with controversial issues admitting that they are controversial but giving their best judgment on the matter.

In spite of these criticisms I think I can honestly say that I believe that much of the program as I interpret it is in keeping with the ideals and aims identified with the nature movement. It would be more satisfying if there was greater evidence that the program put into practice the essen-

tially sound units to be found in the philosophy preached. It is unnecessary for me to repeat here the specific points of difference which I noted in my commentary published in the Yearbook.

The nature movement is, of course, broader in its significance than is school science. Science also is broader than the phases of it that appear in school curricula. Certainly they boast so much in common that the line of demarcation cannot be drawn with certainty. Each probably claims some territory not recognized by the other but it hardly is significant in terms of the major contributions.

The nature movement inspired by the work of Pestalozzi, Rousseau, Comenius, and others, moulded by years of experience and the best efforts of Jackman, Bailey, Comstock, and Bigelow, and adapted to modern needs with varying success by leaders of the present, will not suffer greatly because of differences which exist between its ideals and those proposed in this program of science teaching. It will profit by the revival of interest in the field which this offering will inspire.

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A Discussion of the Yearbook Committee's Report on Science Education in the Senior High School Grades

The first five chapters of the Yearbook Committee's Report present a sane proposal for integrating and articulating our science offerings through all the high school grade levels. The program proposed for the senior high school grades is particularly forward-looking. While this program is not revolutionary to the extent of ignoring what has already been accomplished, it does point the way, in no uncertain terms, to a definite plan to be striven for in the future. Specifically, this plan calls for either biological science or an integrated physical science in the tenth year; either physical science or biological science in the eleventh year, depending on the previous offering; with the opportunity of a further science elective in the last year, either an additional biological course or a second year of physical science. All of these courses are indicated as electives.

For first emphasis in larger high schools and for programming in smaller schools, I believe that the sequence of such courses should be biological science in the tenth grade, physical science (principally physics) in the eleventh grade, and physical science (principally chemistry) in the twelfth grade. As suggested in the Yearbook, it should be possible for the small high school to offer the physical sciences in alternate years.

In the Committee's suggestion of guiding principles and generaliza-

tions for the selection of specific science objectives, there are contained valuable possibilities for science teaching from the elementary school to the university. The indicated set-up makes possible for the first time in the history of science teaching, a plan of organization that leads the pupil progressively from grade level to grade level through appropriate experiences without unnecessary overlapping. Through the suggested sequence he may acquire an intelligent understanding and appreciation of the concepts of science that are important in everyday life.

Now to proceed to a discussion of the chapters devoted specifically to senior-high-school offerings. The chapter on the course of study in biology is commendable in many respects, a few of which may be enumerated as follows: the clear-cut recognition of the need for a tenth grade course in biology; the recognition of the need for organizing the course of study in biology in teaching units; the emphasis placed upon biological principles; the statement that these principles represent a tentative list, with the indication that there is nothing sacred about their particular form or organization; the suggestion of many good reading references.

Although there are many excellent suggestions contained in the proposals for teaching biology, there are several to which I would raise some question. In this connection, mention should be made first of a few of the many difficulties faced by the Committee in making definite suggestions for tenth-grade biology.

In the first place, the most popular textbooks in biology are not written specifically for tenth-grade biology. Although such textbooks have been modified somewhat by materials covered in tenth-grade courses in biology in other states, the fact remains that the same textbooks are being used in New York State for ninth-grade biology, and that they are written largely around the present elementary biology syllabus—a ninth-grade syllabus. Since these books are used in the majority of secondary schools in this country, their influence upon the teaching of this subject is obvious to all who are familiar with the situation.

The lack of experimental data on grade placement of materials is also recognized. To my knowledge, until very recently there has been no significant attempt to organize a sequence of offerings so that pupils may take general science in junior-high-school grades and follow this course with a biology course in the tenth grade without being exposed to serious overlapping of materials. Such a sequence has been completed recently for New York State.

It is, therefore, not surprising to find a lack of definite proposals for tenth-grade biology in the Yearbook chapter on biology. Although the chap-

ter assignment calls for a discussion of biology as a senior-high-school subject, and although the elementary and junior-high-school grades are treated in another section of the Yearbook with adequate references to teaching materials, including those biological in nature, the author of this chapter, however, somewhat confuses the issue by discussing the teaching of biology over a range from the elementary grades through the senior high school. The principles of biology set up in this chapter, therefore, cover the whole field of biological teaching and are not confined to the high school biology course. Any suggestions with reference to an organization of a tenth-grade course around these principles are, therefore, apt to be misleading. Unfortunately the outline in its entirety will probably be adopted in the exact form presented for tenth-grade courses, regardless of the statements of the author of this chapter that much of the material suggested may have been previously taught in other grades.

With the suggestion that the course of study in biology be organized in teaching units, I agree absolutely, but feel strongly that the teaching units suggested here are too often logical abstractions, and not psychologically adapted for the best organization of subject matter. I believe the organization presented would result in a formidable, logical course, justifiably subject to the same criticism as that which applies to our present topically organized courses in the physical sciences. The Committee statement in the first chapter is clear: that the principles and objectives set up are to be used as guides. It is not my understanding that they are to be used as teaching units. For example, among the concepts proposed in the biology chapter appears the following: "The cell is the structural and physiological unit in all organisms." This should not be used as the objective of a specific teaching unit, but may be better developed under several different teaching units; for example, under such studies as the cell basis of nutrition, reproduction, heredity, evolution, etc., although these are not presented as unit headings.

It seems to me that a faulty emphasis has been given in this chapter on biology to the scientific attitudes, the skill in thinking, to the inductive method, the deductive method, etc. This material is no more applicable to biology than it is to the other sciences offered in high school. Furthermore, it does not seem to reflect the thought of the Committee as a whole as expressed in the first few chapters of the Yearbook. As indicated in other portions of the Yearbook, these attitudes should be developed along with every phase of subject matter as an attendant learning product and not be singled out as a unit of instruction any more than *character* or *honesty* would be singled out as a unit of instruction in the social studies.

In the Yearbook proposals for the physical sciences, an interesting and accurate picture of the tendencies in enrolment and offerings in the physical science field has been presented. This background serves as an introduction to the Committee proposals. In no other field, perhaps, is there more need for reorganization than in the physical sciences. The possibilities for reorganization in these fields, particularly with reference to physics and chemistry, are pointed out with the proper and healthy suggestion that something needs to be done about it. The general suggestions should be of help to anyone interested in course of study revision in this field.

It is gratifying to note the absence of reference to "applied" types of physical science courses. On the other hand, the author of this chapter indicates that the approach to the proper development of generalizations in this field should be made through practical applications. This suggestion is excellent, and if followed, should lead us away from the formal and deductive treatment that has characterized much of our physical science teaching.

Technics for selecting materials for teacher-training courses have been pointed out in the Yearbook, and a definite program of teacher training has been indicated. Recommendations concerning the desirable number of hours in introductory and special science fields are excellent and administratively feasible. Until all state departments of education revise their certification requirements, it will be difficult to secure a concerted movement in the proper direction among the teacher-training institutions. Much can be done, however, through local administrators who are in a position to use the minimum requirements set up as criteria for the selection of their teachers. Teachers in training may also be guided in their graduate work by the suggestions of this committee.

Finally, it must be remembered that not any one of us is infallible, that much of the Yearbook represents individual points of view and that we should make optimum use of its many good suggestions, rejecting those proposals which we feel are not justified.

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Comments on the Thirty-First Yearbook, Part I, of the National Society for the Study of Education

The following comments have to do with three phases of the report, namely, the recommendations for a twelve-year science program, science for the elementary school, and science for the junior high school grades.

The comments are intended to be constructive and not critically destructive, since the writer believes that the Committee has prepared an outstanding contribution to the cause of science teaching in the elementary and secondary fields.

It is, of course, impossible for any committee to determine and synthesize completely the viewpoints of science teachers and supervisors of diverse experiences and problems. Hence, such a report as this must represent rather distinctly the personal opinions of the committee influenced by such information as to the views of others as they are able to secure and by research. It seems to the writer, therefore, that each individual science teacher or supervisor should attempt to interpret findings and recommendations of the Committee as they apply to his own particular set of problems. If the Committee's fundamental proposals are sound, science education will rapidly assume a greater importance in the eyes of administrators.

The Twelve-Year Science Program.—Any discussion of a twelve-year science program must necessarily include a consideration of the philosophy on which it is based, the objectives to be attained, and the content and method needed to promote advancement of the pupils toward a realization of the objectives.

I find myself in rather complete agreement with the philosophies advanced by the Committee, which are summed up in the statement "A curriculum in which learning experiences should be arrayed in such a manner that as the child progresses through successive grades, he will have opportunity for continuous enlargement of his knowledge of the problems, principles, and generalizations that scholarly men find worthy of study." Such a criterion for the development of a science program will necessarily provide experiences for the child which will result in "simple sense perceptions, conceptions, and generalizations" that will enable him more adequately to understand, appreciate, and enjoy his environment. These learning products should, in turn, help to develop those attitudes of mind which affect conduct in a social environment.

Such a philosophy of science education certainly does not indicate need for specialized science during the elementary or junior high school grades and, in my opinion, points the way toward less specialization than is practiced at present in the senior high school.

I do not find myself entirely in accord with certain recommendations of the Committee. For example, an objective of junior high school instruction mentioned is "to reveal the fields in which there is opportunity for more intensive and specialized study of science." While science in the

junior high school undoubtedly does make such revelations, which special interests are cared for by science clubs, I do not think that this should constitute a specific objective for these grades.

Neither do I believe it is wise to provide for extensive specialization in the tenth, eleventh, and twelfth grades. The recommendations of the Committee for these grades appear somewhat ambiguous. To quote from the report: "It seems entirely practical to suggest for the three years of the senior high school an elective of at least four one-year units. These should probably be organized as two two-year sequences, one in the field of biology and the other in the field of physical science." Again to quote, "In general the course in biological science should precede the course in physical science and students should not take a second-level course until they have taken the first-level course in both of these fields." The first of these statements implies that a pupil entering the tenth year would be advised to choose either the two-year biological sequence or the two-year physical science sequence; which would follow out the suggestion of the Committee that "in the senior high school there is opportunity for exploration within the special fields. For the pupil it is an exploration and possibly a beginning of specialization." Such a program would provide opportunity for undue specialization and the likelihood of the elimination of experiences in the field not chosen. Since the physical sciences involve exactness which many pupils wish to avoid, it seems to the writer that the biological sequence would be over-crowded at the expense of the physical science sequence.

On the other hand, the report states specifically, as quoted above, that the first-level course in each sequence should be taken before the second-level course is taken. Such an arrangement definitely interrupts the sequential idea since, if pupils choose the two-year biology sequence and are required to inject a year of unrelated physical science, the result is no improvement over present practice.

Furthermore, the Committee report provides for the beginning of biology or physical science in the tenth year. This also is objectionable because of the lack of dependent continuity and because the first unit of the physical science cannot be designed successfully at the same time for tenth-year pupils who have not had geometry and eleventh-year pupils who have had geometry, to say nothing of other experiences. So far as the writer can determine, the recommendations of the Committee do not definitely provide for an integrated and interdependent program of science for the senior high school, but leaves this field in the same chaotic condition that it is at present. The writer wishes the weight of authority, which

this report will carry to administrators, placed squarely behind a program for the senior high school, involving three years of integrated science which would work toward the gradual discontinuance of the present unsatisfactory practice.

The program suggested does not appear to provide for differing abilities and needs such as may be presented by pupils going to college and those not going to college, unless the biological sequence becomes, as the writer fears, the non-college course.

Particularly important is the statement "Definable educational values from science teaching will have been attained if students acquire: (1) An ability to utilize the findings of science that have application to their experiences; (2) An ability to interpret the natural phenomena of their environment; (3) An appreciation of science attitudes through understanding and ability to use some of the methods of study that have been used by creative workers in the field of science."

Certainly objectives of this type remove the work in science far from the traditional type of teaching which involves information about science as the major aim. Furthermore, I agree with the committee that the difficulty of measuring attainments of pupils in the realization of desired objectives is no reason for lack of proper emphasis.
culty of measuring attainments of pupils in the realization of desired ob-
jectives in terms of usable concepts and generalizations rather than a range of information outline. The facts utilized in acquiring an understanding or an appreciation may be and frequently are forgotten. However, the understanding which is represented by a principle or generalization is applied and reapplied until it becomes a part of one's belief; a belief based on evidence. This belief may be changed as new evidence is presented, but it will never be forgotten.

It happens that our science courses of study in Rochester were all re-written in 1928, 1929, and 1930, after three years of study, around what we have called major and minor concepts. These do not conform in all respects to the findings of Craig's splendid work, although there are many points of similarity and had we had the results of Craig's study earlier it would have saved us an enormous amount of work. Therefore, our own experience leads me to believe that the setting up of the generalizations by the Committee will prove of great assistance to all science teachers and supervisors who desire to formulate their courses after the recommendations of this Committee. The Committee points out that these generalizations are by no means to be final, either in the way they are stated or in their selection. The proof of their value will lie in their usefulness

to pupils as tools that will enable them to explain or understand and appreciate their environment and themselves.

Science in the Elementary School.—The program recommended for the elementary school is developed in such a way as to leave little, if any, uncertainty in the mind of the reader. The generalizations being based upon a study as accurately and completely done as that by Craig, leave little opportunity for discussion based on mere opinions without an equal background of research. However, the statement by the Committee that "directing the activities of children toward the significant and profound concepts of modern life is not visionary, it is being achieved by many classroom teachers at the present time," could profitably be reinforced by a more practical illustration as to how the material may be presented in the classroom. To be sure there are illustrations as to how a certain generalization may be analyzed into experiences which may be made the basis of the development of the major concept. There does not, however, seem to be any plan that the average teacher, "blessed with forty children," repeating hour after hour, may put into operation. Miss Average Teacher in the elementary school has very little time and less experience that will enable her to present science according to the new recommendations. It is far simpler to follow the traditional outline of content. The writer hopes someone may come forward, in the near future, with a simple illustration of how the Committee's recommendations may be carried out in a real situation. The recent syllabus in elementary science, issued by the University of the State of New York, presents one practical way of developing some of these generalizations. Our Rochester course presents another, although it is very tentative at present.

Anyone examining the list of objectives set up as satisfying the various criteria might express doubt as to the desirability of some of them. For example, it is hard to believe that elementary school pupils are concerned with the fact that "there are fewer than 100 elements," or that "all matter is probably electric in structure," or that "the properties of different elements depend upon the number and arrangement of the electrons and protons contained in their atoms."

A discussion as to who shall teach elementary science must be answered, in the average school system by the statement: it will be taught by the regular elementary classroom teacher, if it is to be taught with any completeness now or in the near future. Always among a group of elementary school teachers there are some who are interested in nature. These teachers must, I think, form the nucleus about which the teaching of elementary science must center. The immediate problem, therefore, for the

training of elementary science teachers becomes one of training the teachers in service. It will be many years before adequately trained teachers of elementary science will be available in sufficient numbers. One practical difficulty here will be the fact that the teacher who is adequately trained to teach science in the elementary school will very likely be suitably trained for science teaching in the junior high school. Generally the salary paid the junior high school teacher exceeds that paid the elementary school teacher. Therefore, we cannot expect to encourage the best trained science teachers to accept positions in the elementary school until there is equality of salary opportunities.

Committee Recommendations for Grades 7, 8, and 9.—I have already taken issue with the Committee's stand as to the second function of science in the junior high school grades, namely: "To furnish an introduction to the major field of science so that the pupil may become sufficiently well acquainted with these fields that he will be able, with some assurance, to determine in which branch or branches he may later desire to do more specialized work." Space does not permit adequate discussion of this recommendation. It is hoped that this recommended function of junor high school science may be made the problem of research. With many teachers and administrators it seems poor practice to provide for specialization in science as early as the tenth year of a pupil's schooling. If this is true then the need for the above function ceases. It is the elective system, which attempts to provide outlets for what often prove to be false leads of interest, that has resulted in the complexity of offerings, which in turn has increased the cost in various subjects, especially science.

The Committee's stand in favor of the same type of science organization for grades 7, 8, and 9, regardless of the type of school system organization, is certainly to be approved. Science, developed and taught along the lines recommended by the Committee, provides the sort of training and experience that is a fundamental need in the lives of every pupil, regardless of the type of school system in which he finds himself.

Perhaps a corollary of the committee's recommendation in this respect might be a disapproval of a variety of courses in so-called related science in these grades. It certainly appears sensible to hold that pupils taking vocational training require the same fundamental concepts and generalizations as their fellow pupils who are in the academic fields, since they live and work in the same environment and are beset by the same child problems. Certainly a teacher of vocational pupils should be on the alert to direct the pupils to make applications of the acquired concepts and generalizations to the particular vocational field with which they happen

to be associated at the time. In this way the special needs of pupils will be provided for.

The principles of selection and organization recommended by the Committee deserve special attention since here are presented definite specifications for the science program of the junior-high-school grades.

The limited suggestions made by the Committee with respect to the methods of instruction, both in the elementary grades and in the junior-high-school grades are commendable and forward looking. It is hoped that concrete examples of this work may be prepared and published for the benefit of those who do not have time to give the thought necessary to its adequate development.

Nothing that has been said in the foregoing should be assumed in the slightest degree to detract from what the writer believes to be the best proposal for a program for the teaching of science that has been made. It is thoughtful, scholarly, and practical, and will do much to safeguard and promote the interests of science teaching.

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Further Comments on the Yearbook from the Psychological Point of View

The following discussion deals almost exclusively with chapters four and five, although, since these chapters are foundational, it carries implications which have the peculiar faculty of breaking out here, there, and elsewhere in the report, much like measles.

Chapter V presents the Committee's basic psychology. While I object to the opening statement which carries the claim that psychology, rather than philosophy, answers the question of "what knowledge is of most worth," my principal criticism is that the psychology is fundamentally mechanistic, and that this fact appears to lead to marked unclearness at crucial points with consequent difficulties which result therefrom.

The psychological theory is basically that of Thorndike; one that starts with the assumption that all human behavior is explainable on the basis of a type of neural action which is nothing more than various combinations of reflex arcs (S-R bonds), of greater or lesser degrees of complexity. On the basis of this theory, learning becomes a matter of establishing stimulus-response connections. Note the similarity of this statement and the following quotations:

> Learning may be seen as a progressive and continuous process of forming connections between situations and responses (p. 42).

> The stimuli of experience are the determiners of human thought (p. 60).
>
> The facts of the environment furnish the stimuli for activity and they condition the response (p. 60).
>
> The process of learning is one of forming situation-response connections (p. 75).

The "psychological principles that may guide the teacher," given on page 66, are unquestionably based on Thorndike's laws of learning. What other interpretation can be made of the following:

> 3. Consciousness of unanswered questions brings a state of dissatisfaction which is removed by finding the answers to the questions. This satisfaction strengthens the bonds (associations) formed. (Principle of satisfaction.)

The difficulty with the Thorndike psychology is that it does not give an adequate explanation of human behavior. It assigns to habit a fixity which habit does not possess. It makes the stimulus the prime mover of human action, rather than one of the directive factors. It makes the right performance of a novel act merely a matter of chance, and not one of precise, planned action. In fact, by removing purpose from the picture, it leaves nothing to human action but blind mechanism.[1] The main point of this paragraph is to show that there is much reason for doubting the adequacy of the psychological theory set up by the committee.

One of the consequences of the Committee's theory is that they become very unclear when they begin to talk about the place of thinking in the educational scheme. In chapter IV, we read:

> "The objectives may be formulated (1) as statements that function directly in thinking, (2) as statements that describe methods of thinking, and (3) as statements that describe attitudes toward products of thought and toward methods of thinking" (p. 43).

We take it that these three objectives are: (1) generalizations, (2) thinking, and (3) attitudes. But, after encountering two or three more statements of objectives later in the chapter, in which first thinking, and then attitudes, drop out, we come to the following statement at the close:

> "It (the Committee) recognizes the objectives of science teaching to be the functional understanding of the major generalizations of science and the development of associated scientific attitudes" (p. 57).

This final statement omits thinking altogether, yet the Committee gives considerable discussion to problem solving (pp. 62-63), and, too, we find, on page 67, four different attempts at a definition of thinking, all of which prove to be will-o'-the-wisps, rather than dependable enlightenment.

We might suggest that this particular difficulty lies in the fact that the Committee does not distinguish between recognition and *thinking*. Let us illustrate. For the hungry child, an apple becomes something-to-be-eaten.

It is recognized as such, without hesitation. This process can be called "recognition." But the apple may have been discovered hanging to a tree, too high to be reached from the ground. There is no evident means of getting the apple, and a period of hesitation ensues, involving a consideration of the consequences of several different modes of action. Here we have a problem, otherwise there would have been no hesitation; and when a problem arises, the stage is set for "reflective thinking." Recognition occurs when a phenomenon and its meaning arrive together. A problem arises when the meaning fails to arrive with the phenomenon, and, according to Bode, thinking is "a process of finding and testing meanings."[2] Thus, training in reflective thinking involves the posing of problems, with careful attention given to the method of arriving, in a precise manner, at dependable solutions.

Now, generalizations serve as bases for recognition, and, if our covering aim in education is merely "life enrichment" (p. 42), then the development of wider bases for recognition (more generalizations) will constitute progress toward the goal. But, although generalizations may be gained through thinking, pure chance (trial and error learning) may also do the trick, and, moreover, information given by the teacher will probably do it more quickly than either. Therefore, if generalizations are to be the primary end, why the Committee's concern about problems and problem solving?

If, on the other hand, we are seeking to develop *intellectual independence* on the part of the pupil—that is, if he is to be trained away from dependence on teacher assistance and toward self reliance—then we must train him in a method of *arriving at* generalizations, and in becoming progressively more independent in so doing. In other words, if educational outcomes are to have real, permanent values, the child must be given training in reflective thinking, and such training is directly dependent upon the solving of problems. What else does Dewey mean when he says, "The essentials of method are therefore identical with the essentials of reflection"?[3]

But, as the reader may readily see, this view makes training in reflective thinking *primary,* and the establishment of generalizations *secondary.* This would mean that we should be principally concerned with making the curriculum rich in possibilities for challenging problems; that this should be the direction for research in curriculum studies, rather than that so much effort be spent in making a "scientific" study of present-day social practice for the purpose of finding the generalizations which should be taught.

It therefore becomes evident that the clarification of this one point, namely, the place of thinking, makes considerable difference to many important features of the Committee's plan. The question is, where would we arrive should we canvas all cases where unclearness is evident. Other points which would come up, should we do this, would be, what is meant by "experience," by "generalizations," and by "functional knowledge," and just where we are when we accept "life enrichment through participation in a democratic society" as the general aim of education. We are thankful for one thing, however, and that is for the emphasis on generalizations and principles, rather than on the retention of scientific facts.

[1] For discussions which elaborate this criticism, see the following:
Bode: *Conflicting Psychologies of Learning*, Chaps. 10 and 11.
Lashley: *Brain Mechanism and Intelligence*, pp. 151-177.
Thayer: *Passing of the Recitation*, Chaps. 6 and 7.
Wheeler: *Science of Psychology*, pp. 233-237, 315-324.
[2] Bode: *Modern Educational Theories*, p. 200.
[3] Dewey: *Democracy and Education*, p. 192.

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Abstracts 

General Education

COOK, W. W. "The Advancement of Teaching." *Bulletin of the American Association of University Professors* 18:6-17; January, 1932.

In his address as retiring president of the American Association of University Professors, President Cook discusses such phases of teaching as: (1) the problem of better teaching; (2) the expansion of student enrollment in its relation to problems of teaching; (3) the growth and dilution of teaching staffs; (4) the tenure question; and (5) the number and variety of present-day experiments in improved methods of teaching. There is need for an impartial evaluation of experiments in education. Not all innovations in education are necessarily the most successful ones. Self-discipline is being replaced by self-expression at a time when there is too little of the one and too much of the other.

—C.M.P.

MALLER, J. B. "Age Versus Intelligence as Basis for Prediction of Success in High School." *Teachers College Record* 33:402-415; February, 1932.

This is the résumé of a research whose purpose was to determine the relationship between the age-grade status and scholastic success of high school students. Records of 5783 high school seniors were examined. The average age of graduation was 18.00 years, ranging from 17.41 years to 18.34 years. An analysis of the data obtained shows that age correlates with scholarship to about the same degree as does intelligence. The average scholarship of high school students can be predicted as reliably from a mere knowledge of the students' ages as from knowledge of the students' scores on an intelligence test. In neither case is the correlation high enough for individual prediction. Multiple correlation of scholarship with age and intelligence is higher than the correlation with either one of the two latter variables.

—C.M.P.

BECKER, CARL H. "Secondary Education and Teacher Training in Germany." *Teachers College Record* 33:262-278; 347-363; December, 1931 and January, 1932.

This is the last of a series of three lectures delivered at Teachers College by Professor Becker, former Minister of Education of Prussia (1919-1930). In the first lecture Professor Becker showed that the new ideals of education, while not born of the revolution, were at least set free by it. In the present articles the author describes the new program of secondary education in Germany and the character and aims of the new German teacher training system. The German secondary school is a nine-year school, beginning about the tenth year and extending to the nineteenth year. Graduates of this school are about the equivalent of American College sophomores. Since the war, German secondary education has been more diversified, more flexible and more elastic. At the same time an attempt is being made to insure unity and coherence in a national system of education.

The general preparation of elementary teachers is undertaken in the secondary schools, but their professional training takes place in special teachers' colleges. All teacher training is centered around the personality of the teacher rather than on the curriculum. Secondary teachers are trained in universities but only rarely do elementary teachers receive training in universities.

—C.M.P.

VANDYKE, GEORGE E. "Trends in the Development of the High-School Offering." *The School Review* 39:657-664; 737-747; November, December, 1931.

Following the procedure used by Stout in his study of the development of high school curricula in the North Central States and using thirty-five of the same schools used by Stout, the author shows the trends in the development of high school curricula. He finds that in these thirty-five schools the number of different courses offered is practically six times as great in 1929-1930 as it was in 1906-1911. In the field of science the number of different courses in these two periods respectively is in the ratio of one to two. Data indicate that among the usual subject groups of the secondary curriculum, science has decreased from 22.7 per cent in the period 1906-1911 to 10.2 per cent in 1929-1930. The increase in different courses offered in science has been far less than in many of the other subject groups. Science contributes only ten per cent of all the courses offered—and this in an age of science! —C.J.P.

WEAVER, ROBERT B. and TRAXLER, ARTHUR E. "Essay Examinations and Objective Tests in United States History in the Junior High School." *The School Review* 39:689-695; November, 1931.

An interesting comparison of the results of essay examinations and objective tests in United States history in the junior high school, the elements of which comparison are suggestive to the science teacher. The summary of the study states "When the essay test and an objective test are carefully made and when the scoring of the essay examination is kept as objective as possible, the tests have about equal merit in measuring the understanding of pupils in United States history." —C.J.P.

BRIGGS, THOMAS H. "The Committee of Ten." *Junior-Senior High School Clearing House* 6:134-141; November, 1931.

The first of a series of articles presenting critical evaluations of the more influential reports of National Committees dealing with the secondary school curriculum. The Committee of Ten report is considered by the author to be interesting "chiefly as a contribution to the history of secondary education and as a repository of sound suggestions that education has not yet adopted." —C.J.P.

Science Education in General

EVERETT, MABEL L. "Shall We Teach Fables or Truth?" *Educational Method* 11:140-142; December, 1931.

The implication of this article for science teachers is contained in the first short paragraph:

"Most of us are thoroughly convinced that ostriches bury their heads in the sand, whenever they become frightened. We believe this fable because Herodotus, in the fifth century B.C., told this story to his people as a sort of parable or fable."

The article does not discuss the question of the fable as a part of educational materials, in the sense in which the term is usually used, but is rather a plea for accuracy and exactness in the statement of facts taught. The illustration used to make the point is the inaccuracies in textbooks regarding the life and environment of the Eskimo. The contents of twenty-eight textbooks, sixty-five courses of study, and twenty-one articles in teachers' magazines is reviewed and compared, as to accuracy and richness of concepts developed with authentic sources of information.

—O.E.U. and G.S.C.

WEIMER, B. R. "Practical Avocational Science." *School Science and Mathematics* 32: 44-47; January, 1932.

An outline of a course "Our Outdoors" offered at Bethany College. The object of the course is primarily the development of the habit of using leisure time to stimulate interest and secure satisfaction in living and learning in Nature's great out-of-doors.

—A.W.H.

Woods, Elizabeth L. "Some Research Findings of the White House Conference on Child Health and Protection." *Educational Research Bulletin* (Los Angeles) 11:62-63; January, 1932.

Some of the findings of the White House Conference on Child Health and Protection were: "Of 45,000,000 children under 18 years: 6,000,000 are undernourished; 1,000,000 have damaged hearts; 1,000,000 have speech defects; 675,000 are 'problem' children; 500,000 are dependent; 450,000 are tubercular; 300,000 are crippled; 18,000 are totally deaf; 14,000 are totally blind."
—C.M.P.

Reed, Rufus D. "Range of Subjects Taught, Teaching Load, and Preparation in Science of the Science Teachers of New Jersey." *Journal of Chemical Education* 9:326-343; February, 1932.

This investigation shows that beginning science teachers may expect to teach two or more subjects, about one-third of the science teachers teaching a non-science subject. General science is usually taught in the ninth year, biology in the tenth, physics in the eleventh, and chemistry in the twelfth year. As a rule general science classes do not have laboratory work. As to number and size of classes, the sciences ranked as follows: general science, biology, chemistry and physics. About one-third of the science teachers are women, who intend to teach biology. The median training in science for science teachers was found to be about three years each of biology and chemistry, one-and-one-half years of physics, and about one-half year of the earth sciences. —C.M.P.

Tyler, Ralph W. "Ability to Use the Scientific Method." *Educational Research Bulletin* (Ohio State University) 11:1-9; January 6, 1932.

Methods have been developed by which tests of information may be made objective and highly reliable. The same degree of development has not taken place in the measurement of other objectives. One of these objectives, considered important by every science department, is "to teach students to use scientific methods." The author describes the development of an objective method of testing the ability of the student to draw generalizations from specific data. This method was worked out in botany. In the field of zoölogy a method was worked out to determine the ability of a student to plan an experiment to evaluate an hypothesis. A third test has also been devised to determine the ability of the student to apply principles to new situations. The author concludes that the results thus far obtained justify the belief that scientific method may be measured directly with some degree of precision, even though the task of scoring the answers is time-consuming and a bit tedious.
—C.M.P.

Hurd, A. W. "The Workbook as an Instructional Aid." *The School Review* 39:608-616; October, 1931.

An experimental plan to measure the effectiveness of the workbook in the teaching of high school physics leads to the conclusion that "worksheets tend to help pupils in situations like those studied but . . . they are not indispensable." The experiment suggests a type of investigation which needs to be carried much further.
—C.J.P.

Science in the Elementary School

Persing, Ellis C. "Science Library for Elementary Schools." *School Science and Mathematics* 32:65-77; January, 1932.

More than 200 books relating to elementary science are listed under twenty-eight major headings. These include textbooks and reference books. This list is supplemented by names and addresses of publishers. —A.W.H.

"Symposium." *Progressive Education* 8:631-734; December, 1931.

No one should attempt to organize science programs for elementary schools

without becoming familiar with the various recent points of view in regard to function and method of the elementary school. This issue of *Progressive Education* deals almost wholly with various conceptions of freedom and discipline, and most of the articles in it will prove very enlightening and thought provoking to those who may have been trained in specialized science teaching and have become interested in the development of this subject in the elementary school. —O.E.U. and G.S.C.

Dickson, Belle L. "A Curriculum Based on the Seven Objectives." *Educational Method* 11:210-212; January, 1932.

This program for the primary grades gives rather a limited place to, and narrow view of, the field of science. Activities for the year in this field are represented by a "Children's Pet Exhibit," and "Audubon Bird Club," and a "Wild Flower Exhibit." In connection with the pet show, it is stated that

"The nature study for the month is based upon the various animals owned by the group. The chief contribution in this case is probably the development of a keener power of observation, along with emphasis upon kindness to animals."

Outcomes of patience, sustained effort, etc., are to be achieved through teaching tricks to the pets. Considerable transfer of an unsubstantiated type seems to be implied. —O.E.U. and G.S.C.

Dougan, L. M. "The Place of Literature in the Teaching of Science" *Junior-Senior High School Clearing House* 6:92-93; October, 1931.

A description of the personal experiences of a teacher who believes that there is a real place for the use of literature in science. A few brief poems are used as illustrations to show how science literature may be incorporated in an activity. Criteria for the selection of literature are suggested.

—C.J.P.

Science in Grades Seven, Eight, and Nine

Melone, Gerald H. V. "Unifying Children's Learning Experiences." *Progressive Education* 8:560-563; November, 1931.

This description of organization of seventh-, eighth-, and ninth-grade material around some broad topic or general problem indicates clearly the opportunities for science in such a program. The problem used for illustration is "How Man Has Made the World Serve Him in Modern Civilization." It is divided into four units and the subject-matter for each unit is suggested under some half dozen "learning cores." The first three units are almost wholly based on scientific concepts. Only a teacher well-grounded in the spirit and method of science could direct such a set of activities intelligently. In this particular experiment at the John Burroughs School, instructors from all departments worked together in planning the work.

—O.E.U. and G.S.C.

Sichler, Elizabeth G. "The Types of Activities Which Science Students Prefer." *School Science and Mathematics* 32:163-170; February, 1932.

Some data are given to indicate that both superior and inferior pupils in ninth-grade general science classes choose about equally creative and reproductive project activities when given the opportunity. There seems a slight tendency for superior pupils to choose creative projects, and for inferior pupils to choose reproductive projects. Choice of projects in undoubtedly influenced by past experiences of the pupils in other classes, and popularity of certain prevailing practices in project work.

—A.W.H.

Bauer, W. W. "Getting Ready for Release —Communicable Diseases in the Home." *Hygeia* 11:1132-1135; December, 1931.

The author discusses the present day preparations for release from quarantine in cases of communicable diseases. In contrast with the complicated practices of one or two generations ago, release today consists of "a bath, a shampoo, and clean clothes that have not been in contact with

the infected surroundings." The application of soap and water and exposure to fresh air, heat, and sunshine are observed in cleansing the room and its equipment. Disinfectants are necessary only as directed by the physician. Fumigation is discredited as a disinfectant against germs.

Bacteriological studies show that the most important source of human infection is man himself rather than the inanimate objects that have been near the patient. To make certain that no trace of activity in the disease remains at the time of release, the patient is examined and tested thoroughly.

During the period of illness the physician has had authority over the patient. With his recovery, authority is transferred to officers of the health department whose chief concern is the safety of the public. The extent to which individuals accept community safety as more important than personal conveniences, prevention of communicable diseases will be more effectively accomplished. —F.G.B.

Nettels, C. H. "Pupils' Reactions to General Science Courses." *Los Angeles Educational Research Bulletin* 11:1-5; September, 1931.

This article is the résumé of a study made of the science interests of one-hundred upper-grade high-school pupils enrolled in chemistry. Girls seemed to have wider science interests than boys and also were more critical of the general science offerings. Boys were more interested in physics and chemistry while biology and astronomy were more interesting to the girls. Pupil opinions of science are quoted. On the whole, pupils have a most favorable reaction toward general science.

One semester of general science is required in the lower half of the eighth grade of the junior high schools of Los Angeles. This course consists of: plant life, seven to nine weeks; animal life, seven to nine weeks; and natural forces applied to man's welfare, three to five weeks. A year of elective general science is offered in the ninth grade. This course, elected by approximately one-half the pupils, emphasizes the physical aspects of science.

—C.M.P.

Shoults, Worth E. "Antarctica's most Interesting Citizen." *The National Geographic Magazine* 61:251-260; February, 1932.

The author describes the life of the comical penguin who is both romantic and bellicosse. Eight excellent photographs showing the penguin in his Antarctica home are included. —C.M.P.

Atkinson, Agnes Akin. "Befriending Nature's Children." *The National Geographic Magazine* 61:199-215; February, 1932.

The article describes a five-year experiment in feeding some of nature's children. Food is placed on a large rock table where various animals come each night to feed. Observation is made possible by flooding this rock with light. At first many of the animals were very timid about the light, but now they seem quite accustomed to it. The article is illustrated with twenty-six excellent photographs. —C.M.P.

Science in the Senior High School

Hurd, A. W. "Teacher Opinion and Suggestion on Teaching Units in Physics." *School Science and Mathematics* 32:33-43; January, 1932.

Questionnaire data from forty-three schools using a specified experimental teaching unit suggest that (1) coöperating teachers follow experimental directions which do not depart too widely from conventional practice; (2) a minimum essential and project program offers hope of improved teaching practices if ample time is reserved for the project work; (3) too much is being attempted in present physics courses; (4) well-planned projects stimulate interest and develop worthy traits of character; (5) pupils are generally interested in work sheets; (6) carefully prepared work sheets make requirements definite and concise and tend to produce more

satisfactory pupil achievement; (7) sociological objectives are important criteria for selecting subject-matter, and choice of pupil activity will be wiser if immediate objectives are more clearly defined; (8) the use of one textbook and few references are common practices in physics.

—A.W.H.

Bray, Willis J. "A Study of Achievement of Students of General Chemistry in College." *School Science and Mathematics* 32:19-29; January, 1932.

This is a study of the factors that condition student success in college chemistry. Five Missouri state teachers colleges coöperated in the research. The author's conclusions based on apparently reliable data show that (1) students begin the study of college chemistry with a wide range of ability in the subject, and, on the average, practically double their achievement level in one quarter's study of chemistry; (2) there is a wide range of mental ability in the whole group studied; (3) those who graduated from larger high schools generally exceeded, especially those who studied chemistry or physics in high school; (4) students who elect chemistry excel, and men excel women in general. —A.W.H.

Baker, H. W. and Phares, L. I. "A Chemistry Exhibit." *Journal of Chemical Education* 7:500-509; March, 1932.

This article describes a chemistry exhibit held in the Battle Creek, Michigan, high school in May, 1931. It explains how the exhibit was planned and carried out. Ten photographs of the exhibit are included.

—C.M.P.

Dunbar, Ralph E. and Walker, Esther. "The Chemistry Bulletin Board." *Journal of Chemical Education* 9:510-511; March, 1932.

This article discusses the uses and types of science bulletin boards. Suggestive lists of materials which students and teachers may each contribute to the chemistry bulletin board are included. —C.M.P.

"Symposium: Precious Metals." *The Chemistry Leaflet* 5:1-32; February 18, 1932.

This issue of *The Chemistry Leaflet* deals with the three precious metals: gold, silver, and platinum. Sources, present supply, uses, alloys and atomic structures are described. —C.M.P.

"Symposium: The World's Clothing Supply." *The Chemistry Leaflet* 5:1-32; December 17, 1931.

This issue of *The Chemistry Leaflet* discusses wool, silk, cotton and linen as to history, uses, tests, etc. Processes of making artificial textile fibers are described. Laundry and dry-cleaning processes are also discussed. —C.M.P.

Weeks, Mary Elvira. "The Discovery of the Elements." *Journal of Chemical Education* 9:3-30; 215-235; 459-485; January, February and March, 1932.

In this series of articles the author traces one by one the history of the discovery of each of the elements. Consequently interesting bits of the biography of each individual associated with the discovery of each element is given. An extensive bibliography is included. —C.M.P.

Steiner, L. E. "Contribution of High School Chemistry Toward Success in the College Chemistry Course." *Journal of Chemical Education* 9:530-537; March, 1932.

A comparison is made between the records of the first-year chemistry students of Oberlin College who have had one year of high school chemistry with those who have not had high school chemistry. Findings were: Students who have had one year of high school chemistry make better chemistry grades in college than students who have not had high school chemistry. The chances of students continuing college chemistry are about three to one greater if the student has had high school chemistry. —C.M.P.

Strohaver, George F. "The Pandemic Idea in High School Chemistry." *Report of New England Association of Chemistry Teachers* 33:39-44; November, 1931.

The experience of the author during the last five years in teaching a pandemic

course in chemistry to college students has convinced him that such a course is vastly superior to the older traditional method of introducing chemistry to students. Manifestly such courses are not for those students intending to further pursue the study of chemistry. The author believes that such a pandemic course should be taught in high school where it will serve both as a cultural course and for purposes of educational guidance. Better high-school-chemistry teaching would result, both to the benefit of the high-school student and to the college. Such courses would teach all of the scientific angle, and in addition how the chemist works, and what his work means to mankind. —C.M.P.

Mayforth, Valentine. "Work Done With Underweight and Nutritional Cases at the DeWitt Clinton High School." *High Points* (New York City) 13:9-13; October, 1931.

A report which shows work done with underweight and nutritional cases in a New York City high school. Concrete statements are given concerning (a) how these cases are detected, and (b) how the students are interviewed and served. Each case appears for twelve interviews in the nutritional clinic. In each interview a special aspect of nutrition is considered. The case has a final disposition and a report is made to the teacher who recommended the student for examination. —C.J.P.

Dane, Maybelle G. "The Place of Mineralogy in Biology." *High Points* (New York City) 13:59-60; October, 1931.

A brief description of how important rocks produce soil and how the rocks are, therefore, indirectly related to biology. The author makes clear the place of simple activities relating to minerals in the biology course. —C.J.P.

New publications

Hunter, George W. *Problems in Biology.* New York: The American Book Company, 1931. 706 p. $1.76.

In this book the author introduces the large unit idea which is quite common to general science textbooks but as yet somewhat unusual in the secondary-science textbook field. There are twenty units with five major divisions as follows: (1) Living things in relation to each other and their surroundings; (2) Green plants make the food of the world; (3) Relationships and inter-relationships of living things; (4) The biology of man; (5) Man's inter-relationship with other living things. Each unit is introduced by a number of survey questions followed by a preview of the unit. Next comes a series of problems which are often introduced by means of laboratory exercises and demonstrations. Self-testing exercises, achievement tests, individual projects, and practical exercises are included.

The subject-matter seems to be well-selected and well-adapted to the ability levels of secondary students beginning the study of biology. Sufficient material has been included so that the textbook should fit into most teaching situations. Some elimination of subject-matter will probably be necessary. This is not necessarily a criticism of the book but rather one of its most worth-while features. The book is excellently and profusely illustrated, including many colored pictures. In the opinion of the reviewer these illustrations are one of the most worth while features of the book and have evidently been selected on the basis of their value as a teaching device.

There is only one criticism that the reviewer wishes to make. That relates to the list of useful reference books found at the end of each unit. No distinction is made as to whether they are pupil or teacher references or both. In some cases the reviewer would also disagree as to the books selected, regardless for whom they are intended. The usefulness of the references might have been greatly increased had more attention been paid to the points to which reference has just been made.

It should prove to be a book, popular with both pupil and teacher. The test of a textbook's ultimate success depends on the answer to the question: Is it teachable in the average class room situation? The reviewer believes that the answer, in this case, will be emphatically "Yes."

—C.M.P.

Heal, Edith and Others. *The Story of the World.* Chicago: Thomas S. Rockwell Company, 1930. 12 uniform volumes. 112 pages to the volume. $1.25 each.

With the growth of science in the public schools, and the movement toward the introduction of progressive methods, there will be an increasing demand for authentic supplementary reading material in science.

This series of books is designed to meet some of the needs of the classroom by supplying specific information that children can read in connection with the units of instruction. The volumes have been reviewed by specialists in the particular fields of organized knowledge that are involved in the presentations. By using all of these books, a large body of authentic informa-

tion in science in the child's own language is made available.

The books are illustrated in an attractive manner. The individual volumes are listed below with a brief description and the recommended grade placement of the publishers.

How the World Began, by Edith Heal—traces the story of the earth from its beginning to the coming of man. It is recommended for fourth grade.

How the World is Changing, by Edith Heal—covers such topics as: the changes on the surfaces of the earth; the inside of the earth; the effect of the earth upon man. This book is recommended for seventh grade.

How the World Grew Up, by Grace Kiner—is a story of anthropology. It is recommended for the fourth grade.

The Garden of the World, by Janet McGill—is a story of botany. Some of the topics covered are: plants without seeds; sunlight factories; food for plants; storage rooms; man made plants. It is recommended for sixth grade.

The World's Moods, by Maryanna Heile—is a story of weather. Some of the topics treated are: the air around us; night and day; heat and cold; water in the air; the wind; thunder and lightning; balloons and airplanes; the weather man. It is recommended for sixth grade.

The Physical World, by Janet Pollak—is a story of physics. It treats with such topics as: gravity; push and pull; what heat can do; things in motion; why we see; why we hear; electricity. It is recommended for grade eight.

What Makes up the World, by Elizabeth Hayes—is a story of chemistry. It gives an elementary treatment of such topics as: oxidation, fire, water, air elements, chemical change. It is recommended for seventh grade.

Other Worlds Than This, by Elena Fontany—is a story of astronomy. It is recommended for eighth grade.

The World of Insects, by Margaret Powers—is a story of entomology. Some of the topics given treatment are: insect societies; insect industries; insect warfare; insect travelers; mysteries of insect world; do insects live by instinct or intelligence; what would happen if insects were banished? It is recommended for junior and senior high school.

The World of Invisible Life, by Mary Stephenson—is a story of microscopic life. It is recommended for junior and senior high school.

How the World Is Ruled, by Carrie Louise George—is a story of government. It is recommended for fifth grade.

The World of Animals, by Mary Stephenson—is a story of animals. It contains a great deal of interesting information about structure and habits of various types of animals. The material is well selected. It is recommended for fifth grade.

—G.S.C.

Ambler, Mary B. and Others. *The Story of Man.* Chicago: Thomas S. Rockwell Company, 1931. 8 uniform volumes. $1.25 each.

This series of books treats with some of the topics of the program for social studies. The series give a rich fund of supplementary reading material for this field. The books are well illustrated and are authenticated by specialists in the field of knowledge involved. A brief description of each volume is given below:

Man and His Riches, by Mary B. Ambler—is a story of economics and is designed for junior and senior high school.

Man and His Records, by Franklin Barnes—is a story of writing and is designed for junior and senior high school.

How the World Lives, by J. V. Nash—is a story of sociology and is designed for the seventh and eighth grades.

This Man-Made World, by Anthony R. Fisher—is a story of inventions and is designed for junior and senior high school.

The Tongues of Man, by Elizabeth Hayes—is a first book to read on languages, and is designed for the seventh grade.

Man and His Customs, by Margaret Fry—is a story of folkways, and is designed for junior and senior high school.

How the World Supports Man, by Dorothea H. Davis—is a story of human geography and is designed for junior and senior high schools.

Races of Men, by J. V. Nash—is a story of ethnology, and is designed for seventh and eighth grades.

—G.S.C.

Harvey-Gibson, R. J. *The Master Thinkers.* London: Thomas Nelson and Sons, 1928. 238 p. $1.20.

The author has written this book for beginners to make clear the "evolution of science—from its birth in the minds of the Greek philosophers, to its adolescence at least, though not to its maturity in the twentieth century." He divides this period of over 2,500 years into "four chief epochs: first, the classical period . . .; second the period of the eclipse of science, when the flickering flame was kept alive by the Arabs; third . . .the dawn of modern investigation . . .; lastly, the period of the rising sun. . . ." It is written in more engaging style than many

biographical works because the various biographical accounts are bound together by the underlying plan of the book as expressed above and shown in the ten chapter headings. And yet interest is inherent also in the personality of each man receiving mention.

It will serve as a better reference book in this field for intermediate-, junior-, high-, and senior-high-school pupils, or as a brief history for any interested person. Portraits, some of them especially good, increase its value by making it more human in its appeal. It should be in every school and public library. —A.W.H.

HAWKES, ELLISON. *The Romance of Transportation*. New York: Thomas Y. Crowell Company, 1931. 333 p. $3.00.

With the ease and comfort of planning a trip of travel today, we find it difficult to realize the difficulties of people of other days. The author helps us to visualize and to understand the modes of travel and of transportation from ancient days to the present. The part that science and invention has played in this development is told in interesting stories and graphically shown illustrations. This book portrays in language understood by junior high pupils the conquest of space by man. It describes characteristic modes of travel in many lands besides giving much historical matter on the progress of transportation. It supplies very useful material for the unit on transportation for general science classes. —W.G.W.

FAIRCHILD, DAVID. *Exploring for Plants*. New York: The Macmillan Company, 1931. 591 p. $5.00.

This is the personal narrative of a scientist's adventures in Europe, Africa, the Canary Islands, and the Far East, exploring for new plants capable of being grown for food, for commerce, and for the beautification of homes and gardens. The book is illustrated with one hundred ninety half-tones. The author is a botanist of note, president of the American Genetic Association, and a director of the National Geographic Society.

Employing a literary style so personal that it makes the reader feel that he, too, is a member of the Allison Vincent Armour expedition for the United States Department of Agriculture, 1925-1927, the author describes the expedition from its beginnings in England to its completion in Portugal. The description of the native life and flora of the countries visited, together with comments regarding the food habits and taboos peculiar to each country, makes this an unusual story of travel and adventure. How strange do the customs and life of other lands seem to us.

Hundreds of new plants were brought back to the United States for experimentation to determine the use to which they may be put. If, in the next few years new plants appear in our commerce and on our tables as food, credit may probably be given to the Fairchild Plant Expedition of 1927. The reviewer recommends Exploring for Plants as unusually interesting supplementary reading material for biology students and others who may desire to know more about the plant life and peoples of other lands. —C.M.P.

CLARK, AUSTIN H. *Nature Narratives* (Volumes I and II). Baltimore: The Williams and Wilkins Company, 1929 and 1931. 135 p. and 100 p. $1.00 each.

Each volume contains fifty short stories of amazing facts about living things. Many of the stories seem stranger than fiction and one comes to the conclusion that it is a mysterious world in which we live. The sketches written in a style that is lucid and vivid should appeal to biology and general science students and further increase their interest in animal life.

A few of the hundred interesting sketches are: "Avian Apartment Houses," "Rains of Blood," "Imitation Earthworms," "Metal Chewers," "Animal Arithmetic," "The Ant That Makes You Cry," "A Question of Ethics," "Fragrant Butterflies," "Butterflies as Human Food," "Animal-eating Plants," "Sea-snakes," "The Stegosaurus" and so on. —C.M.P.

MEIER, W. H. D. and MEIER, DOROTHY. *Biology Notebook*. Boston: Ginn, 1931. 160 p. $0.72.

This notebook is intended to accompany the authors' *Essentials of Biology*. Included are a set of suggestions to the teacher on the use of the book, a list of laboratory apparatus for a class of 25 pupils, a set of general directions for pupils, emphasizing the use of the microscope, and the directions for carrying on some 80 laboratory and observation studies. Guidance for the pupil is furnished in directions for work and questions to be answered. Spaces are ruled after the directions and questions for tabulations and answers to questions. Directions cover both textbook assignments and laboratory work.

The book is arranged in loose-leaf form in paper covers with rings for holding the pages. Other pages may be inserted if the teacher or pupil desires. Only one side of sheets is used. Paper is of good quality and will take ink readily. Teachers who are using the authors' text or considering its use should examine this notebook.

—R.K.W.

Imms, A. D., *Social Behavior in Insects*. New York: The Dial Press. 1931. $1.50.

This is the first of a series of monographs on biological subjects to be published by the Dial Press. The series is British in authorship. Subjects in preparation cover such subjects as Mendelism, microbes, biochemistry of muscle, the biology of sex, and respiration in plants. The more interesting parts of the present volume are concerned with the behavior of the social wasps and bees. The first chapter on the nervous systems of insects is illuminating and should contribute to the reader's knowledge of nervous systems and brains in general. Every observer of animal life has been intrigued by the communities of bees, wasps, and ants. This brief volume of a little over one hundred pages should go far towards building up an intelligent understanding of such communities on the part of the layman or the busy high-school-science teacher.

—R.K.W.

Coulter, J. M., Barnes, C. R., Cowles, H. C., and Fuller, G. D. *A Textbook of Botany* (Volume Three: Ecology). New York: American Book Company, 1931. 497 p. $2.80.

This is a revision by Professor Fuller of the third volume of the original edition of Coulter, Barnes, and Cowles standard textbook in college botany. This volume deals with ecology. The book is distinctly pitched at the college and university level and is not suitable for elementary students. The book is not as technical in its terminology as the original edition and therefore seems more readable. The book attempts to present fundamental conceptions of botany. It is not an encyclopedia of reference for all kinds of plants. No teaching devices are included. The elaboration of the material is left to the teacher. There are many illustrations and these are always pertinent to the text. At the back is a bibliography classified according to the topics covered by the individual chapters. The book is to be recommended to teachers looking for an authoritative text in this field. Those teachers who used the earlier edition will welcome this revision.

—R.K.W.

Kenly, Julie Closson. *The Astonishing Ant*. New York: D. Appleton and Company, 1931. 251 p. $2.50.

The author discusses the habits of ants in an imaginative and some frivolous manner. The spirit of the book is established in the first chapter when the reader is asked to accompany the author into the ant world, in his imagination to shrink to the size of an ant, and to picture the things about him as they would probably appear through the eyes of ants. The habits of ants are emphasized through a discussion of such topics as the nuptial flight, the work of the queen and members of her colony, various types of ants homes, ant armies, and ants in amber. The stories in the book are based on facts taken from literature written by authorities on ants. They are made fanciful by attributing to ants the ability to think and plan. The book is illustrated by wood cuts by Henry C. Kenly. —F.G.B.

Plunkett, Charles Robert. *Outlines of Modern Biology*. New York: Henry Holt and Company, 1930. 711 p. $3.75.

The word modern in the title of this text is entirely appropriate. The book is entirely modern in its whole outlook and conception. The text is organized about the important principles of biology which underly all life. It has departed entirely from the old classifications of plants and animals as a basis of organization. The student instead of struggling to memorize technical names of unfamiliar plants and animals goes directly to those problems of life which he has been groping to understand.

Major divisions of the book are concerned with the following topics, protoplasm, nutrition, response, reproduction, and evolution. Through each of these divisions there is an attempt to help the student build up understandings of fundamental concepts rather than merely to stand.

Illustrations are relatively few and these are in the form of diagrams intended to clarify the text.

The book is recommended to college teachers who feel the need for a textbook in biology as a definitely organized science rather than as a compromise of descriptive material concerning plants and animals. Intelligent laymen will find this modern college text enjoyable and profitable reading. —R.K.W.

HAMAIDE, AMELIE. *The Decroly Class* (tr. by Jean Lee Hunt). London: J. M. Dent and Sons Ltd., 1924, 1927, 1931. 309 p.

Those interested in elementary-science teaching should keep in touch with the progressive movement represented by the Decroly classes in Belgium, as they are putting into practice the principles of modern educational psychology as presented by Dewey and others, and at the same time giving it a strong scientific bias.

"It is necessary then, that the study of nature be conceived in the active sense, as a matter of practical experiences and effective utilization of the surroundings, should be the center of a program of subject matter based on pedology. As a result the well-considered teaching of natural sciences must be accorded a more important place in our program, a place beside the mother tongue as the core of the curriculum."

The above quotation from Dr. Decroly's writings heads the chapter on educational point of view and methodology. Phrases such as "Let the child learn by living," "organize the environment to afford adequate stimuli for the tendencies favorable to development," "learning through living" and so on, indicate the point of view of Dr. Decroly's philosophy.

"Dr. Decroly insists on a program of logically developed relationships; takes for his point of departure experiences at first hand observation, . . . Above all he would have subject matter drawn from those sources that nature affords at all times and in such profusion. . . . the subject matter used in the majority of these device materials is drawn directly from nature."

In order to prepare the child for life Dr. Decroly believes that the curriculum should concern itself with (1) living creatures in general—man in particular, and (2) the surrounding universe, inclusive of society. Choice of centers of interest from topics dictated largely by the seasons has been abandoned except in grades one and two, and a single center such as "food," "protection from the elements," "defense against enemies and danger," is developed throughout a year. Such centers are considered not only from individual, family, school, and society, but also from the animal world, the vegetable world, the mineral world, and the heavens.

The three types of activity adopted by Dr. Decroly as a basis for organization, rather than the conventional "branches of instruction"; observation, association, and expression are developed in Chapters three to five. Many illustrations are very suggestive to teachers of elementary science. One of the aims of the observation lessons is "Acquainting him (the child) with the complex ideas of life, that he may be led gradually to a realization of the facts of evolution in relation to himself." "A Demonstration," (Chapter eight) illustrates how science material is woven into the general program. Chapter ten on "Type

Programs" also furnishes many such suggestions. —O.E.U. and G.S.C.

STEVENS, BERTHA. *Child and the Universe.* New York: The John Day Company, 1931. 249 p. $3.75.

This book has to do with children, education, and natural science. It offers a plan whereby natural science becomes the core of education for two successive years during the primary-school period. The author believes that science is so important, involves experiences so fundamental, and at the same time has some concepts so simple that children even in the primary grades (ages seven and eight) can study it to an advantage. In the words of the author "Earth study should begin at the earliest age when normal children first look beyond their immediate personal experience, and it should never end. Science should be presented as a whole—not detached as so much physical geography, nature study, geography or elementary science." The author stresses the importance of fundamental concepts rather than facts which in themselves may mean little. "Man and natural law are associated inseparably, the universe including man is one coördinated system, and they must be considered together in any educational plan that is basic, vital and complete." Much of the author's work has been carried at the Avery Coonley School, Downer's Grove, Illinois.

The following units are discussed: Why Study the Universe; Principles and Methods; the Earth in Space; The Inside of the Earth; The Earth's Surface; The Earth's Atmosphere; Beauty and Rhythm; and Articulation with a Curriculum. The book contains forty-eight full page photographs which are remarkably clear-cut. They represent about the best job in photography which the reviewer has noted in a long time. Although the book is based on the author's experiences in a progressive activity school and the program may be more suited to that type of school, all teachers, parents, and those interested in elementary science will read the book with enjoyment and profit. It is a book for adults, but not a textbook or course of study. —C.M.P.

SAIDLA, LEO E. and GIBBS, WARREN E. *Science and the Scientific Mind.* New York: McGraw-Hill Book Company. 1930, 506 p.

This book is intended to serve as a textbook in advanced composition for students of science and technology. The central theme is the scientific habit of thought. The authors have collected a body of nontechnical, scientific articles of merit which serve to clarify the meaning of science and the scientific method. Four or more essays have been selected for each of the main divisions of the book: Science; The Scientific Mind; The Scientific Motive; Science and Culture; The Place of Science in a Liberal Education; Science and Civilization; and Science and the Future. The essays are by such writers as: Millikan, Barry, Tyndall, Slosson, Curtis, Sullivan, Huxley, Osborn, Shaler, Soddy, Pupin and Haldane.

The appendix contains a list of suggested topics for discussion and reports, together with reading references and biographical notes of many noted scientists. The book is recommended to high school science teachers and to others interested in discussions of scientific methods and scientific attitudes. Dr. Truman L. Kelley has contributed an excellent essay relating to mental traits of men of science.

—C.M.P.

PITKIN, WALTER B. *The Art of Learning.* New York: Whittlesey House (McGraw-Hill Book Company) 1931. 409 p. $2.50.

The art of learning has been very much neglected in the opinion of the author. Vast sums of money are spent annually on our public schools in an effort to educate children and in training teachers how to teach, but not a penny is spent to teach those pupils how to learn! In this book the author attempts to show how this much neglected art of learning may be mastered, at least partially, by anyone who sincerely has the desire to learn. It is a book intended for adults either in school or out of school. After "knocking down many straw-men that too often hinder learning," the author outlines plans whereby one may become more skillful in the

art of learning in the one or more of the many fields that may interest the reader. Concrete, practical suggestions are offered in each of three fields of learning that the author believes to be of greatest significance: psychology, geography and mathematics. Whether you agree with him or not, the frank opinions expressed by the author are calculated to make one think. The author offers no easy road to learning or to material success. It is a workbook, based on workable principles of psychology. The style, that of a newspaper journalist, should appeal to many, although to the reviewer it seemed at times as if the style bordered too much on the sensational. Read the book for enjoyment. It may be that you will profit from it! —C.M.P.

BAGLEY, WILLIAM C. *Education, Crime, and Social Progress.* New York: The Macmillan Company, 1931. 150 p. $1.20.

William C. Bagley has long been known as a teacher of teachers. His *Determinism in Education* a few years ago aroused a great deal of comment among those concerned with the educative process. In his latest book, *Education, Crime and Social Progress,* Bagley criticizes our educational system and points out what, in his opinion, are needed revisions in education.

Education must assume, at least partial responsibility, for two important problems confronting the American people: (1) the very serious problem raised by technological unemployment; and (2) the equally serious problem revealed by the heavy crime ratios, the rising curves of divorce, and other signs of a pathological individualism (as disrespect for law). Two immediate weaknesses in our education are: (1) the notion that all learning activities must take their cue from the spontaneous purposes of the learner, and (2) the tendency of teachers to follow the latest "fashions" with great zeal and little discrimination. The author believes that there has been too much "playing at the work of education," along with needless, naïve irresponsibility, profitless adventuring, now masquerading as educational experimentation." True freedom comes not through allowing the learner to make free choices regarding tasks and programs of study, but rather through discipline and greater emphasis on ideals and high standards. The needed revision in education is education for adaptability. —C.M.P.

NELSON, GEORGE E. *The Introductory Biological Sciences in the Liberal Arts College.* New York: Bureau of Publications, Teachers College, Columbia University, 1931. 135 p. $1.50.

This study is a doctor's dissertation in which the author evaluates the effectiveness of the teaching of the introductory biological sciences in the liberal arts college by determining, "first, whether or not the present teaching objectives are directed toward valid educational goals, and second, whether or not present objectives, practices, and outcomes represent what may reasonably be expected from introductory courses in biology." The author discusses the adequacy of the present objectives of teaching the introductory biological sciences; the extent to which courses in introductory biological sciences are directed toward acceptable objectives as illustrated in actual practice, in several thousand examination questions, and in textbooks; the extent to which extra-curricular biological materials contribute to valid objectives of biology teaching; and the evaluation by use of valid and reliable tests, of "accomplishments with respect to objectives sought in practice and the objectives acceptable to liberalized teaching."

This study will be of great value to all who are interested in improving the teaching of introductory courses in biological sciences in the liberal arts college.

—F.G.B.

New York Commission of School Ventilation. C. E. A. Winslow (Chairman). *School Ventilation: Principles and Practices.* New York: Bureau of Publications, Teachers College, Columbia University, 1931. 73 p. $1.00.

This is a final report summarizing the entire commissions investigation. Conclusions drawn from their studies, covering a period of eighteen years, shows very clearly that many of our state laws and city regulations need revision. They find that the

window-gravity method of ventilation for school classrooms may be as satisfactory as, and often is more satisfactory than, the fan system. It is a book for those interested in school welfare to digest and for architects to consider. —W.G.W.

Moore, F. J. and Hall, William T. *A History of Chemistry*. New York: McGraw-Hill Book Company, 1931. 324 p. $3.00.

This revised edition of *A History of Chemistry* retains the general plan of the earlier edition. Recently discovered data have, in a few cases, necessitated the restatement of facts. For example, it is pointed out that alchemistic doctrines prevailed in China as early as they appeared in Egypt. The revised edition contains the biographies of important chemists who have died since the first edition was printed in 1918. To those chemistry teachers who desire to add a little more of a "human touch" to their teaching, this book is recommended as a worth-while addition. High school students will find their chemistry course enriched by using this book as a source of supplementary reading material. —C.M.P.

Hobbs, William Herbert. *Earth Features and Their Meaning*. New York: The Macmillan Company. 1931. 517 p. $4.50.

This is a revision of a book in geology that has gained wide popularity both as a textbook and as a reference book. Its readability, scientific accuracy, style, and excellent illustrations have contributed to this popularity. There are five hundred and eight apt illustrations. The author emphasizes the cultural aspects of geology. Little or no attention is paid to the historical side of geology. Laymen as well as elementary- and secondary-science teachers who may desire an understanding of their physical environment will find this book an excellent source of information. It should prove very useful as a reference book in the geological aspects of survey or orientation courses in science. —C.M.P.

Coit, C. Marjorie (Editor). *Projects in Science and Nature Study at the American Institute Children's Fair*. School Service Series Number Six. New York: Department of Education of The American Museum of Natural History, 1931. 64 p.

During the last three years the American Museum of Natural History has sponsored a Children's Fair arranged by the School Nature League. These fairs during the last three years have been entirely the expression of the science interests of boys and girls. Various schools interested have exhibited their science work, both group entries and individual entries. Ninety-seven schools were represented by exhibits in 1930. Exhibits are judged on the basis of their intelligent presentation of sound ideas. The bulletin describes several of the prize-winning exhibits from each of the several classes represented. In many cases photographs of the exhibit accompany the description of the exhibit. Science teachers, sponsors of science clubs, and others interested in science project work, will find some very worth-while material described in this bulletin. —C.M.P.

Carpenter, Harry A. and Wood, George C. *Science Discovery Book*. New York: Allyn and Bacon, 1930, 1931. $0.67; $0.75; $0.75.

There are three *Science Discovery Books* to accompany the three textbooks, *Our Environment*, by the same authors. The books present a series of interesting projects, a variety of tests, pupil-rating devices, and space for recording the results of field investigations. Each book is so organized that it follows the unit-plan organization of the textbook. The wide range of material enables the teacher to take care of individual differences among pupils. The loose-leaf arrangement of each book permits greater freedom in selection and arrangement of material. Extra pages have been added at the end of each book for additional experiments, and observations, and for pasting drawings, clippings and pictures. The three discovery books become progressively more difficult. Science teachers whether using the authors' textbooks or not, will find some very useful supplementary material in these discovery-

books. Teachers using the authors' textbooks can ill-afford not to have these discovery books. They will improve the science teacher's efficiency and make the science work much more interesting to the pupil. —C.M.P.

Baker, Robert H. *The Universe Unfolding*. Baltimore: The Williams and Wilkins Company, 1932. 140 p. $1.00.

This is the second of The Century of Progress Series of science books, each written by an authority in a particular field of science. The present volume gives an account of the evolution of the universe. The story opens with man on the scene, looking about him, trying to determine what the heavens may be, making interpretations, and drawing conclusions. The universe unfolds before him, at times very slowly, at others with almost explosive rapidity. From the tiny universe of Homer to the stupendous universe of today is a story of man's progress under conditions of great difficulty. At the beginning of the "century of progress," whose achievements are to be commemorated by the Chicago World's Fair of 1933, astronomers had been unable to measure the distance of a single star and as late as 1900 the distances to about sixty were known. Today we know the distances to about two thousand. As the scheme unfolds, two things arouse our admiration—the vast universe around us and the mysterious mind of man that is able to make interpretations of that universe. High school students and science teachers will enjoy this story of man's increasing comprehension of the universe around him. —C.M.P.

Newman, F. H. *Recent Advances in Physics (Non-atomic)*. Philadelphia: P. Blakiston's Son and Company, 1932. 378 p. $4.00.

Recent Advances in Physics is a well-written book of 365 pages, dealing for the most part with the various branches of radiation. The subjects are handled in separate essays which are very complete and clearly written and the bibliography accompanying each chapter is full enough to be useful. Perhaps the material of most value is that concerning the theory of magnetism.

There is much material collected in this volume that is quite hard for the average student of modern physics to find and it will fill a genuine need. —B.A.W.

Slack, Edgar P. *Elementary Electricity*. New York: McGraw-Hill Book Company, 1931. 278 p. $2.00.

The author has attempted to explain the principles of direct and alternating current so that they may be understood by students in vocational and industrial schools who have had no mathematics above arithmetic and who have not studied electricity before. The book includes a chapter on "Vacuum Tubes and Radio Reception" in addition to nine other chapters which rather conventionally cover the common elementary principles of electric current, generators, motors, power, and distribution systems. The plan is to explain and illustrate by diagram the principle, and then give problems involving it as practice material for the student to use in order to see that he does or does not understand. The vocabulary is quite well adapted to the type of student in mind though the style is matter-of-fact and not particularly stimulating. The subject treatment is sound and if a student desires to get an understanding of elementary electricity, he may here find accurate explanations. There is evident, however, a foundation of considerable training in physics and engineering on the part of the author and there may well be a question whether the student he has in mind will not miss some of the underlying concepts because they are often assumed rather than explained. In other words, though the author has tried to simplify his explanations, it is doubtful that they are always as simple as he thinks.
—A.W.H.

Persing, K. M. *Laboratory Chemistry Test*. Bloomington, Illinois: Public School Publishing Company. $0.15.

The test consists of two forms: Form A and Form B. The test is an objective measurement of the achievement of pupils in the laboratory technique of high-school

chemistry. Each form contains sixty-nine test items. Items were selected on the basis of an analysis of laboratory manuals, laboratory guides, and direction sheets.
—C.M.P.

Stewart, A. W. and Ashbaugh, E. J. *Physics Test*. Bloomington, Illinois: Public School Publishing Company. $0.15

The test is divided into two parts: Mechanics and Heat Test; Electricity, Sound and Light Test. Each test has two forms: Form 1 and Form 2. The tests may serve as either "end of the semester tests" or for diagnostic purposes. —C.M.P.

Sangren, Paul V. and Marburger, Walter G. *Michigan Instructional Tests in Physics*. Bloomington, Illinois: Public School Publishing Company, 1929. $0.10.

The authors have devised a set of twenty-two instructional tests on various phases of physics. Manual of directions, key, and sheets for class record are included. There is also a separate initial test, and also a separate final examination test covering the whole field of physics.
—C.M.P.

Kilzer, L. R. and Kirby, T. J. *Inventory Test for the Mathematics of High School Physics*. Bloomington, Illinois: Public School Publishing Company. $0.15.

The test consists of two parts, together with a key. The purposes of this test are: (1) to point out to mathematics teachers those items in their subjects which are useful to high school physics, and to provide a means for testing the pupils on these items; (2) to assist the administration in guiding pupils in their choice of high school physics; (3) to provide an inventory test which may be given by the physics teacher during the first week of the course.
—C.M.P.

Woodbury, David O. *Communication*. New York: Dodd, Mead and Company, 1931. 280 p. $2.50.

This is a non-technical book suitable for general reading, or for reference in classes in the upper grades or high school. It gives an interesting account of communication in the history of man beginning with the early picture language of primitive man, tracing its development in signaling, the mails, telegraphy, telephony, radio, and television. To be sure, electricity and its applications to communication play a major rôle in the story. The underlying principles of electricity are explained in such a manner that one may here get a conception without going into detailed technicalities of how they have revolutionized commnication in the last hundred years. Even television is made fairly intelligible. The romantic aspects of discovery and invention are also emphasized in pleasing style. A reading of this book gives one a much more coherent conception of the effects of communication in determining the pattern of present-day life. The chapters on, "Communication in the Great War," "Special Applications of Communication," "Communication and Public Welfare," and "Past, Present, and Future," are especially serviceable in this connection. Several good photographs, and a bibliography of books on related topics, are useful additions. —A.W.H.

Felix, Edgar H. *Television*. New York: McGraw-Hill Book Company. 1931. 272 p. $2.50.

Everybody wants to know something about how television is accomplished, particularly those mechanically or scientifically inclined. Television is far from the stage of perfection reached by sound-radio. Its progress will undoubtedly be advanced by those interested in finding out all that is now known about it and in making possible contributions toward improvement. This book succeeds admirably in explaining the underlying principles in a simple, untechnical manner understandable to the high school or college student, or educated layman. While this kind of explanation must be limited in detail, it gives the uninitiated reader a considerable background of knowledge of facts and principles, and indicates the inherent difficulties involved in successful television. There are seventeen chapters, each one treating a signifi-

cant phase of the subject. Chapters III to IX, inclusive, treat of the six fundamental processes in one of the most successful systems: breaking up the original picture by a scanning process; converting the light impulses into electric current impulses; wave transmission and reception; converting waves to electric current impulses; converting the electric current impulses back into light impulses; and forming the reproduced image by a reversed scanning process. Photographs and diagrams which help to clarify the explanations are included in goodly number. The book is suitable for all public, high-school, and college libraries. —A.W.H.

Cowan, Lester, Editor. *Recording Sound for Motion Pictures*. New York: McGraw-Hill Book Company, Inc., 1931. 404 p. $5.00.

This book is published under the direction of the Academy of Motion Picture Arts and Sciences in Hollywood. It contains twenty-four chapters written by as many electrical and acoustical experts in the field of sound pictures. The purpose of the book is to explain, particularly for students in the field, the varied phases of recording and reproducing in the theatre sound pictures. Considerable attention is given to the RCA photophone system, the Fox movietone system, and the Western Electric light-valve system. Valuable information is given also on practical aspects of theatre reproduction, acoustics, problem difficulties, and personnel organization. A glossary of motion-picture terms is a worth while feature. Many photographs and diagrams are included. The book is necessarily technical, but quite up-to-date in so far as any book dealing with such a progressive subject can be. Anyone interested in studying sound pictures will find it indispensable.

—A.W.H.

Tentative Syllabus in General Biology. Albany: The University of the State of New York Press, 1931. 62 p.

This is the new syllabus for tenth-grade biology for the state of New York. The outlines were prepared by a committee consisting of Ralph C. Benedict of the Haaren High School, New York City; Edna Craig of the Newburgh High School; Mervin E. Oakes of Teachers College, New York City; George C. Wood of the James Monroe High School, New York City; and Warren W. Knox, State Supervisor of Science.

The course is definitely planned for the tenth year of high school and designed to follow general science in the ninth year. The attempt is to make an integrated course which aids in building up understanding of basic life processes. There are four major divisions; man's place in a world of living things; self-preservation among living things; race preservation among living things; and man's increasing control over his environment and over himself. The whole course is divided into eleven units with a time allotment varying from two to five weeks for each. Unit divisions and their sub-divisions are indicated by declarative sentences implying the major ideas of the division. It may be doubted if this has a distinct advantage over topical statement.

Each unit of the organization is developed under the following divisions: the purpose of the unit; the development of the unit, which indicates the subject-matter to be included; suggested procedure and activities; references for the unit. A general bibliography is to be found at the end of the syllabus.

Most thoughtful workers in the field of science education will agree that the type of organization attempted here is a step in the right direction. Biology has needed an organization based upon fundamental ideas of the science. The *suggested procedure and activities* for each unit should prove helpful to teachers using the syllabus. These may be improved by the contribution of other similar activities by teachers who use the syllabus. The committee definitely states that the syllabus is tentative and invites criticism and recommendations. Workers in the field of high school science should examine the type of organization suggested. Commit-

tees from other cities and states revising science curricula should examine this syllabus. —R.K.W.

Frank, J. O. *The Teaching of High School Chemistry*. Oshkosh, Wis.: J. O. Frank and Sons, 1932. 285 p. $3.00.

Nineteen chapters of most practical suggestions on the multitudinous problems of teaching chemistry. Not only is there elaborate discussion of objectives, policies, methods, and even philosophies, but there are lists galore of text books, library books, reference books, apparatus and supplies, films, slides, and all the other supplements which an experienced teacher has found useful.

The chapter on "Classroom Methods of Teaching Chemistry" would grace any text on general method—a "content man," after all, may know how to teach. In the discussion that has grown warm concerning the usefulness of the laboratory in elementary science, the chapter on "Laboratory Teaching" sheds light. Teaching plans for both the high-school and the junior-college level are given for the science. A chapter on "Tests and Measurements" not only supplies a list, but presents all the arguments for the "new-type" forms. There is also a chapter on self-grading for the teacher. This book is most liberal in its offerings of lists of library books, sources of industrial material, visual aids, and other scattered helps. It is not the author's fault that such lists become out of date rather quickly.

Methods for the teaching of qualitative and quantitative analysis are included. This does not imply that all high schools offer such courses, but gives the teacher material for a "short course" or special opportunity for the gifted student.

But one expected help is lacking—an index. The "Table of Contents," however, is very clear. —H.A.W.

Willey, Arthur. *Lectures on Darwinism*. Boston. The Gorham Press, 1930. $2.00.

Broadly defining Darwinism as the impression produced in the minds of those who read his works, the author adduces certain facts in support of Darwinism which are really extraordinary and remote from daily experience. Natural selection is of course the keynote of the discussion. Designated as the trivial principle which we owe to Darwin's effective and lifelong exposition, Willey sees it remaining in daily use as a colloquial term, and in hourly operation as a vital factor controlling the destiny and conduct of life rather than its actual mechanism. It has no concern with the physico-chemical constitution of living matter, or with the physico-chemical laws governing the vital processes. Thus we have overlooked the fact that Darwinian selection is concerned with external form and habits, while physico-chemical constitution is related to organic function. Hence Mendelism, mechanism, and Darwinism belong to different categories, although meeting on the common stamping ground of heredity.

Selection then, for Willey, corresponds to what Nehemiah Grew in the 17th century called the "Providence of Nature," as accomplishing adjustments between the place conditions of the environment and the place requirements of the organism. Regulating the interdependence of organisms during their life time, it ceases promptly at their death. An excellent discussion of the various aspects of natural selection—static, dynamic, protective, and productive—is given in the final chapter. To conceive of its scientific value one has only to think of the advances made along the lines of human progress since 1860. As to its future—almost nothing for man has inherited the earth so literally that natural selection has given way to civic selection. It is too vast a truth to be of practical value in the routine of human life today. What is its value in academic biology? To the naturalist, it is the most natural thing in nature, but unfortunately old time naturalists, like chimney sweeps, are a disappearing race. The worst fault of the principle is that it can not be verified experimentally. From being a hotly contested issue, it has become a hollow truth like the bowl of an Eastern sage, chiefly valuable because of its emptiness. —N.M.G.

News and announcements

Harvard University coöperating with the University Film Foundation is experimenting upon 300 students in Junior High Schools of Lynn, Revere, and Quincy, Massachusetts. A text book is in the hands of each pupil covering the same amount of ground. The experiment covers a period of six weeks. Eight films are used. One group has the text and the teacher. The other group has the text, the sound picture, and the teacher. All are given the same amount of class time and there is no outside preparation for either group. The results are awaited with interest.

Dr. Benjamin C. Gruenberg of New York, nationally known educator and author, has accepted a temporary appointment to the staff of the Committee on the Costs of Medical Care, it was announced recently by Dr. Ray Lyman Wilbur, chairman of the Committee.

The Committee has completed practically all the preliminary research in its exhaustive five-year study into the problem of "the delivery of adequate, scientific medical service to all the people, rich and poor, at a cost that can be reasonably met by them in their respective stations in life," Dr. Wilbur announced. Its final report will be published in the autumn of 1932.

Dr. Gruenberg is the author of many books on health and educational topics. Among them are: ***Modern Science and People's Health, Biology and Human Life, Outlines of Child Study, Parents and Sex Education, The Story of Evolution.***

He has been granted a leave of absence by the Viking Press, New York, to take up his post with the Committee. He has been educational editor of this publishing firm since 1929, prior to which time he was managing director of the American Association for Medical Progress.

Committees in the following states have been appointed to revise the courses of study in science in the elementary schools: Connecticut, Florida, North Carolina, South Dakota, Virginia.

At the annual meeting of the American Nature Study Society held at New Orleans during the Christmas holidays, the following officers for 1932 were elected:

President, A. F. Satterthwait, 527 Ivanhoe Place, Webster Groves, Mo.

Representative of the AAAS Council, E. Laurence Palmer, Cornell University, Ithaca, N.Y.

Vice-President, Russell F. Lund, State Board of Education, Hartford, Conn.

Vice-President (Webster Groves Branch), Helen S. Dykeman, 5455 Page Ave., St. Louis, Mo.

Vice-President (New Orleans Branch), James McArthur, 727 Cherokee St., New Orleans, La.

Secretary-Treasurer, Jennie Hall, 2512 Hennepin Ave., Minneapolis, Minn.

The Society voted to hold a meeting at Syracuse, New York, on June 15 to 20, 1932, in affiliation with its parent organization, the American Association for the Advancement of Science.

National Association for Research in Science Teaching

Minutes of the Meeting

The Fifth Annual Meeting was held in Washington, D.C. on February 20th, 22nd, and 23rd, 1932. The first session was a joint meeting with the National Society for the Study of Education and the National Council of Supervisors of Elementary Science, held in the Chamber of Commerce Auditorium on the evening of Saturday, February 20th, at 8 o'clock. This session was devoted to a discussion of Part I of the *Thirty-First Yearbook* of the National Society for the Study of Education entitled, "A Program for Teaching Science." The Yearbook was prepared by a Committee appointed by the Board of Directors of the National Society for the Study of Education. All the members of the Committee were members of N.A.R.S.T.

The programs of the morning sessions of February 22nd and 23rd were carried out as printed in the official program.

The business meeting was held on Monday evening, February 22nd, at 6:30 o'clock. The following members were in attendance:

Florence G. Billig	John Hollinger	Charles J. Pieper
Otis W. Caldwell	A. W. Hurd	S. Ralph Powers
Gerald S. Craig	W. W. Knox	Clarence M. Pruitt
Francis D. Curtis	Morris Meister	Lois Meier Shoemaker
Elliot R. Downing	Victor H. Noll	C. L. Thiele
W. L. Eikenberry	Ellsworth S. Obourn	Ralph K. Watkins
F. A. Riedel	E. Laurence Palmer	W. G. Whitman
Earl R. Glenn	Ellis Persing	E. E. Wildman
Benjamin Gruenberg		

The meeting was called to order by the President, Elliot R. Downing. The minutes of the previous meeting (Detroit meeting) were read and approved. The following report of the Secretary-Treasurer was read and approved.

FINANCIAL REPORT

February 22nd, 1932

Balance on hand February 23rd, 1931	$523.22	
Received dues for 1931:		
14 members at $5.00	70.00	
Received dues for 1932:		
35 members at $5.00	175.00	
Total Receipts		$768.22
Expenditures:		
Postage	$ 2.45	
Telephone to Albany	1.05	
Printing of Programs	19.50	
Printing of Stationery	7.60	
To Science Education for ten shares of stock	500.00	
For 41 subscriptions to Science Education taken from dues	41.00	
Total Expenditures		$571.60
		$196.62
Interest		5.73
Balance on hand February 22nd, 1932		$202.35

The Committee on Publications reported that the proposals as outlined at the meeting in Detroit had been made an attainment in that a group of supporters have purchased the journal known as *Science Education* and that a business organization had been accomplished. The holding body has organized as Science Education, Incorporated, and the Secretary, Mr. Earl R. Glenn, reported that the first year of work had been very successful. The request of the National Council of Supervisors of Elementary Science to use SCIENCE EDUCATION as the official organ of the National Council was brought to the attention of members of the Association. It was voted by the Association that there was no objection to the use of the journal as the official organ of the National Council at the same time that the journal was being used as the official organ of the Association.

The Association's Committee on Teacher Training in the Teaching of Science made a progress report after which it was moved and passed unanimously that the committee be instructed to continue its activities through another year.

The Secretary reported the election of the following members, each of whom had been recommended by the Executive Committee: Victor H. Noll, Office of Education, Washington, D.C.; Palmer O. Johnson, University of Minnesota; Fred G. Anibal, University of Chicago; and Benjamin C. Gruenberg, New York City.

The Nominating Committee, appointed by the President, nominated as officers for 1932 the following:

Francis D. Curtis, *President,*
E. E. Wildman, *Vice-President,*
S. Ralph Powers, *Secretary-Treasurer,*
John Hollinger, *Member of the Executive Committee.*

Members of the Nominating Committee were F. A. Riedel, Chairman; Florence G. Billig, and Harry A. Carpenter. It was regularly moved and seconded that the secretary be instructed to cast a unanimous vote for these officers. The motion was passed unanimously. By the provision of the Constitution, the retiring President becomes the fifth member of the Executive Committee.

The Secretary raised for discussion the question concerning the time of meeting. It was pointed out that even though the Association has been very successful in holding its dinner meetings, it was recognized that there was a direct conflict between the time set for its dinner meeting and the time of other dinner meetings which members of the Association might attend. The importance of steps that would allow for more integration of the membership of N.A.R.S.T. with other organizations was pointed out. Following considerable discussion, it was moved that the business meeting be thought of as taking on a less formal character and that the time of the meeting be set for Sunday evening at 6:30 o'clock. Notice of the dinner meeting is not to be carried in the program. This motion was passed with three opposing votes.

On recommendation from the floor the Secretary was instructed to arrange hotel reservations in block for the 1933 meeting so that a hotel may be designated as the headquarters of the Association.

The President, Dr. Elliot R. Downing, gave as a retiring address a very stimulating presentation in which he pointed out opportunities and needs for research in the field of science teaching. The presentation was followed by discussion from the floor in which many of the members participated.

Before adjournment, it was moved by W. G. Whitman that the thanks of the Association be extended to the retiring officers for their efforts in preparing and presenting a successful program.

S. RALPH POWERS
Secretary-Treasurer

Association of Science Teachers of the Middle States and Maryland

I. Report of the Eleventh Annual Meeting

The Eleventh Annual Meeting of the Association was held in the Roberts Room of the Chalfonte Hotel, Atlantic City, on November 28, 1931, President Winifred J. Robinson presiding. About 60 persons were present.

Before the program, a short business meeting was held. Minutes of the last meeting were read, and the following slate of officers for the coming year was presented for the Nominating Committee by the Chairman, Miss Jessie Rodman:

President—Dr. W. L. Eikenberry, State Teachers College, Trenton, N.J.
Vice-President—Miss Katherine Weaver, Emma Willard School, Troy, N.Y.
Secretary-Treasurer—Miss Elizabeth W. Towle, Bryn Mawr, Pa.

Executive Council—Dr. Winifred J. Robinson, University of Delaware, Newark, Del. (ex-officio); Mrs. Pauline McDowell Atkins, Batten High School, Elizabeth, N.J.; Mr. Henry G. Landis, Northeast High School, Philadelphia, Pa. It was voted that the secretary be instructed to cast one vote for the officers named.

The following report was then made by the Treasurer:

Income

Balance on hand (November 26, 1930)	$ 98.56
Dues received (November 26, 1930 to November 27, 1931)	55.00
Luncheon tickets for 1930 meeting	57.00
Total	$210.56

Disbursements

Luncheon expenses (November 29, 1930)	$ 71.00
Speakers' expenses for 1930 meeting	20.99
Postage	9.00
Stationery	7.75
Printing and typing	16.42
Total	$125.16
Balance on account (November 27, 1931)	$ 85.40

The program which follows this report was then presented. During the discussion that followed, Dr. Louise Nichols commented on the fact that college teachers in general are interested in subject matter rather than in the students. Mr. LeSourd called attention to an article in the November, 1930, issue of Science Education on content of science courses.

Dr. Wildman moved that the recommendations made by Dr. Jameson in his report be accepted by the Association. Seconded and carried. Dr. Dull moved that money be appropriated for further study by way of a questionnaire on College Entrance requirements. Seconded and carried.

After Dr. Montague's paper there was a brief discussion and the meeting adjourned at 12:30 p.m.

Luncheon was served at 1:15 p.m. Twenty-seven guests were present. Dr. Gager's talk after the luncheon was beautifully illustrated with lantern slides.

Elizabeth Towle
Secretary-Treasurer

II. Program of the Eleventh Annual Meeting

Haddon Hall

Atlantic City, N.J.

Saturday, November 28, 1931

President, Dr. Winifred J. Robinson, Dean of Women's College, University of Delaware, Newark, Del.

Secretary-Treasurer, Miss Elizabeth W. Towle, Head of Science Department, Baldwin School, Bryn Mawr, Pa.

Morning Session—9:45 a.m.

Reports of Committee on Curricula.

1. *Committee on Science in Education.*
   Secondary Education Board.
   Dr. Homer W. LeSourd, Milton Academy, Milton, Mass., Chairman.
2. *High School and College Relations Committee.*
   Progressive Education Association.
   Miss Ann Shumaker, Editor, Progressive Education.
3. *Committee on College Requirements in Physics and Chemistry.*
   Association of Science Teachers.
   Dr. Joseph M. Jameson, Girard College, Philadelphia, Pa.

Discussion

Address—*The Bearing of Recent Developments in Science on Philosophy and Education.*
Dr. W. P. Montague, Professor of Philosophy, Columbia University, New York City.

Subscription Luncheon—1:00 p.m., Haddon Hall. ($1.75 per plate.)

Address—*The Educational Work of the Brooklyn Botanic Garden.*
Dr. C. Stuart Gager, Director of Brooklyn Botanic Garden, Brooklyn, N.Y.

III. Abstracts of Reports of Committees and Addresses

Report of Committee on Science in Education

Mr. Homer W. LeSourd, *Chairman*

The secondary Education Board, organized in 1924, represents 140 private (independent) schools whose original purpose was to study problems of college entrance preparation. It now maintains a research bureau whose outstanding activity of late has been a curriculum study, backed by funds from the Carnegie Foundation. The report of this study is to appear early in 1932.

The Committee on Science in Education represents a group of science teachers in both schools and colleges. A study of the place of science in school curricula has recently been made. The results show that at the present time there is no uniformity in science requirements in different schools, but that many schools have recently extended their science courses. The conclusion is that the time is at hand for expansion of science courses. Opportunity should be given for free and unrestrained election of such courses by the students.

Three main problems face those who are planning science curricula:

A. College Domination.

B. Need of Continuity in Science Courses.

C. Obstacles to Freedom of Election.

A. *College Domination.*—Is it on the decline? It seems to be playing a rôle of diminishing importance, and it is a significant fact that in its first session the curriculum committee by unanimous vote decided to make a curriculum which would ignore college

requirements. The objective of a school curriculum is the best interest of the pupil, and in general the teacher in school is better qualified than the teacher in college to deal with such a problem.

B. *Continuity.*—Science courses in schools should provide "a coherent and cumulative sequence." Comparison has been made with the German program "in which each year's instruction grows out of that of the year preceding and gradually forms with it a permanent structure of clear and significant ideas that are related to each other."

Is an integrated science curriculum possible? The difficulties are several: (a) It is difficult to standardize a science curriculum; (b) Unless all courses in such a curriculum are required, there will be inevitable gaps; (c) Textbooks now used do not help; (d) Teachers are too specialized and non-cooperative. With regard to (d) "In spite of conditions which make it impossible and inadvisable for most schools to provide a continuous science curriculum which will be required of all pupils, much can be accomplished which will give greater continuity to the science curriculum if a higher degree of 'team work' is developed among teachers of various sciences in a school. It is for the highest interest of pupils that each teacher acquaint himself with the content and methods of science courses which precede and follow his own, and he should constantly stress those factors which are common to all sciences offered in the curriculum."

Does a course in General Science point the way out? General Science is gaining in favor; it has great value in itself, not simply as an introduction to more specialized science courses. The following list of fundamental topics in science is suggested:

1. Relation of the Earth to the Universe. Theories as to the origin of the Solar System. The sun as our principal source of energy.
2. Work, Energy and Power (simply treated).
3. Nature and Composition of Matter—elements, compounds, mixtures, atoms, molecules.
4. The Water Cycle—evaporation, boiling, condensation, dew-point, relative humidity, clouds, forms of precipitation.
5. The Carbon Cycle—carbon, oxygen, carbon dioxide, photosynthesis, oxidation of food in the body, relation of living things to their environment.
6. The Nitrogen Cycle—free nitrogen nitrifying bacteria, nitrates, dentrifying bacteria.
7. Bacteria and Disease.
8. Transmission of Heat—conduction, convection, radiation.
9. Nature of Sound and Light.
10. Magnetism—magnetic attraction and repulsion, earth's magnetism and the compass.
11. Electrical Units—ampere, volt, ohm, watt, kilowatt-hour.

C. *Obstacles to Freedom of Election.*—Chief among these are: (a) College Requirements—distribution of credits; (b) School Curriculum—certain subjects are blocked in such a way as to render them mutually exclusive; (c) Attitude of Advisers who are unsympathetic with extensive work in science on the part of students.

Report of the Work of the Progressive Education Association Committee on the Relation of Secondary Schools and Colleges

Miss Ann Shumaker, *Chairman*

The Carnegie Corporation of New York has given a grant of Twenty Thousand Dollars ($20,000) to further the work of this Committee which was begun over a year ago. Mr. Wilford M. Aikin, Director of the John Burroughs School, St. Louis, is Chairman of this Committee which includes people outstanding in both the secondary and college field.

This Committee aims to work out plans whereby the progressive ideals now prevalent in an increasing number of elementary schools may be applied in the secondary schools, and to work out better relationships between secondary schools and colleges. This will involve reorganization of curricula to eliminate unnecessary routine requirements and to place greater emphasis upon crucial problems of modern life such as economics, international relations, contemporary culture, the social studies and the like.

The work of the Committee is proceeding along five definite lines:

1. A determination of the principles underlying the purpose and organization of the secondary school.

2. New plans for admission to college, based upon maturity, resourcefulness, general information, as well as tests of power in specialized fields. Emphasis in the new high school is to be upon true mastery rather than upon bookkeeping in credits.

3. An investigation of tests, with recommendations of new tests to be constructed.

4. The drafting of experimental curricula to be tried out in selected centers. There is a tendency to emphasize broad fields of interest rather than more specialized subjects.

5. The revision of college curricula, particularly for the first two years.

It is estimated that the work as now laid out will require two years, with a three to five year period of experimentation to follow.

Address by Dr. W. P. Montague

The Bearing of Recent Developments in Science in Philosophy and Education.

Cultured interest in the sciences has shifted of late from biology to physics. Physics has introduced three new concepts that have been revolutionary in their effect on modern thought. These three concepts are: (1) Relativity, (2) Quantum, and (3) Entropy.

Five main defects in the science teaching of today are:

1. Science is too experimental. It is a fallacy to say that because the laboratory is the place for discovery of new knowledge, it is therefore the only place in which to introduce that which is old. We need a clearer vision of where we are going. The first year in science should be more didactic, should "hit the high spots," giving the exciting conclusions that science has discovered. The students can then select the severer discipline of specialized courses that may follow.

2. Science teaching today is too practical, too pragmatic. The present tendency is to sugarcoat everything with the promise that it is to be practical, thereby making of us a nation of philistines. Every child has a natural love of wonder which must not be lost. If all knowledge is made instrumental to some practical utility, it becomes vulgar.

3. Science is too unpragmatic, in a large way. We are coming more and more to take a part in our own evolution. Students need to be given something of the utopian vision of H. G. Wells, of Lord Haldane; some conception of the possible beautiful and improving uses of science.

4. The freshman year at college is too generally made a continuation year, whereas it should be made one "of danger and innovation," of sampling new subjects, a sort of intellectual Cook's Tour. Intellectual life is not made exciting enough. Students should be introduced to uncensored knowledge, should be "shocked, scared, and jolted!"

5. After the freshman year, we must abandon the idea that we can get a liberal education in everything, otherwise we find that after ten years nothing has been retained to function fruitfully through life. The student should now be introduced to a unified topic that is worth three years of consecutive study.

Program of the Department of Science Instruction

Atlantic City—June 27 to June 30, 1932

President, CHARLES LINCOLN EDWARDS, Supervisor of Nature Study, Los Angeles City Schools, Los Angeles, California.
Secretary, W. L. EIKENBERRY, Head of Science Department, State Teachers College, Trenton, New Jersey.

First Session Monday, June 27, 2:00 p.m.

SCIENCE INSTRUCTION AND SUPERVISION

The Philosophy Underlying Science Education
Samuel Christian Schmucker, Professor Emeritus, State Normal School, West Chester, Pennsylvania.
What Shall be the Science Program for the Junior and Senior High Schools?
Ellis Haworth, Department of Science, High Schools, Washington, D.C.
The Cultural Value of Biology in Secondary Education
Ralph C. Benedict, Resident Investigator, Brooklyn Botanic Garden, Brooklyn, New York.
The Most Important Phase in the Pittsburgh Program of Nature Study
John Hollinger, Department of Nature and Science Instruction, City Schools, Pittsburgh, Pennsylvania.
High School Science
Henry T. Weed, Department of Science, Girls Commercial High School, Brooklyn, New York.

Second Session, Tuesday, June 28, 2:00 p.m.

ELEMENTARY NATURE EDUCATION

Joint Session with The American Nature Study Society

Lessons to be Gathered from Research Studies in Teaching Science at the Elementary School Level.
E. Laurence Palmer, Cornell University, Ithaca, New York.
Children and Other Organisms of Their Environment.
Otis M. Caldwell, Director of Institute of School Experimentation, Teachers College, Columbia University, New York.
The Coördinating Council on Nature Activities.
Bertha Chapman Cady, American Museum of Natural History, New York.
Nature Education at the Brooklyn Botanic Garden.
Ellen Eddy Shaw, Curator of Elementary Instruction, Brooklyn Botanic Garden, Brooklyn, New York.
Nature Education in the Los Angeles City Schools.
Charles Lincoln Edwards, Supervisor of Nature Study, Los Angeles City Schools, Los Angeles, California.
The Development of Nature Rooms in the New York City Schools.
Van Evrie Kilpatrick, Director of Nature Garden Work, New York City Schools, New York.
The Supervision of Elementary Science.
Ellis C. Persing, School of Education, Western Reserve University, Cleveland, Ohio.

Third Session, Wednesday, June 29, 2:00 p.m.

SCHOOL GARDENS

Joint Session with the School Garden Association of America, Van Evrie Kilpatrick, Presiding

School Gardens of Los Angeles.

Albert Marvin Shaw, Hollenbeck Junior High School, Los Angeles, California.

Demonstrations of:

1. A Model School Garden
2. Model Nature Room
3. Model of Institutional Coöperation in Nature Teaching

Committee { Van Evrie Kilpatrick, *Chairman*; Ellen Eddy Shaw; Mrs. Burns }

Fourth Session, Thursday, June 30, 2:00 p.m. to 300 p.m.

(Papers)

3:00 p.m. to 4:00 p.m.

Excursions to Seaside and New Jersey Pine Barrens. Details to be announced later.

New Officers of the National Council of Supervisors of Elementary Science

President—Mrs. Lois Meier Shoemaker, State Teachers College, Trenton, New Jersey.
Vice President—Mr. R. F. Lund, Director of Elementary Science, Hartford, Connecticut.
Secretary-Treasurer—Mr. W. W. McSpadden, Director of Science, Austin, Texas.